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IRA L. WIGGINS

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C. V. MORTON

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American Fern Journal

VOL. 52 JANUARY-MARCH, 1962 No. 1

Plant Compactness and Leaf Production in Botrychium multifidum "ssp. typicum" and "forma dentatum"

W. H. WAGNER, JR.[1]

This paper is an attempt to bring up to date our knowledge of two infraspecific taxa in *Botrychium multifidum* (Gmel.) Rupr. There are two important aspects involved, namely the role of the environment in producing plant compactness and the role of heredity in producing differences in the timing of leaf production.

We must avoid, if at all possible, using characters in the taxonomic differentiation of species and varieties which are non-hereditary, that is, caused only by variations in the environment. Environmental modifications can be very misleading, of course, even to the most careful botanist. However, it is generally recognized that a given species or variety of fern may be modified drastically by alterations in its environment. In damp, shady, warm, rich habitats we can predict that it will become "lax," the leaves taller and more divided; the pinna stalks more elongate; the blade segments longer and more separated and often more toothed; the blade texture thinner; and the sori or sporangia reduced in number or even entirely absent. If transplanted to a dry, sunny, cold, sterile habitat, the same plant

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[1]Research supported by National Science Foundation Grant G-10846. I am grateful to Rolla M. Tryon, Jr., for his help, to Jennie V. A. Dieterle, and to the many people who aided me in the field. My thanks are also extended to the U. S. National Herbarium, the University of Wisconsin, and the Gray Herbarium, for the loan of specimens, and Dr. Motosi Tagawa, of the University of Kyoto, for the gift of comparative materials of *Botrychium*.

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will become "compact," with leaves shorter, less divided; the pinna stalks abbreviated; the segments rounder and approximate or overlapping and more entire; the blade texture thicker and more leathery; and the sori or sporangia abundant.

Unless there is experimental evidence to support such treatment, plants that are distinguished from their nearest relatives on changes like those listed above should not be described as separate taxa. In the past a number of "varieties" and even "species" have been based upon such distinctions as those listed above, and a few examples were given in an earlier paper (Wagner, 1960a, p. 42). To that list we may add such plants as *Athyrium filix-femina* (L.) Roth var. *sitchense* Rupr. (probably the compact ecological modification of *A. filix-femina*), *A. alpestre* (Hoppe) Rylands var. *gaspense* Fern. (probably the lax ecological modification of *A. alpestre*), *Asplenium platyneuron* (L.) Oakes var. *bacculum-rubrum* (Featherm.) Fern. (lax form of *A. platyneuron*), and *Dryopteris fragrans* (L.) Schott var. *remotiuscula* Komarov (lax form of *D. fragrans*). The validity of separating these plants as "varieties" may be tested readily by transplanting them into gardens or greenhouses alongside the typical varieties. The late Mrs. C. A. Weatherby showed me long ago a plant of *Asplenium platyneuron* "var. *bacculum-rubrum*" from the southern United States which had been transplanted to her garden in Cambridge, Massachusetts, near local varieties of the same species. After only a year or two, the "varieties" were indistinguishable. Others have had the same experience. The so-called "taxonomic differences" simply disappear.[2]

The comparative time of leaf production in closely related ferns provides a valuable source of comparative data that seems to be controlled by heredity. It can be modified by environment,

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[2]Members of the AMERICAN FERN SOCIETY might well contribute to our knowledge by making such experiments, being sure to press leaves "before" and "after" as voucher specimens, and to keep precise records. Mr. Donald L. Branscomb of Willits, California, has already acquired much knowledge of the so-called "varieties" of West Coast pteridophytes in his experimental garden.

of course, by keeping the plants in the cold or transferring them to a greenhouse from temperate climates. But if two species to be compared are found growing side-by-side in the same environment and differences in periodicity remain, we must consider these differences hereditary and therefore valid as taxonomic criteria.

Among the ferns only the most obvious cases of interspecific differences in the timing of leaf production have been noticed. In Michigan, the production of fertile fronds in *Athyrium pycnocarpon* follows by fully a month the production of fertile fronds in *A. filix-femina* and *A. thelypterioides* (Wagner, 1955, pp. 225, 234). In *Dryopteris*, the crested woodfern, *D. cristata* is later by at least two or three weeks in fertile-frond formation than *D. intermedia*, *D. spinulosa*, and the other woodferns growing with it in the same habitat (Wagner and Hagenah, 1962).

Such phenological differences as these are of considerable theoretical interest. Why should one species be earlier or later than another species closely related to it? Is there some selective advantage to the early species? The late species? Or are these differences in timing due merely to the past histories of the species? As they migrated and changed their respective ranges through many thousands of years have they accumulated a background of different phenologies? For example, if one species is two or three weeks later than another closely related to it, is it possible that the former had a more northerly evolutionary background, the latter more southerly? These, and many other biological questions, suggest themselves, and the subject of phenological differences between closely related, sympatric species is one that needs research greatly.

In the genus *Botrychium* we have an outstanding example of phenological differences. One group—the deciduous grapeferns (*B. lanceolatum*, *B. lunaria*, *B. matricariaefolium*, *B. minganense*, *B. simplex*, and *B. virginianum*), produce their leaves (in eastern North America) in early spring, shed their spores in early summer, and the leaf dies by fall. However, one species,

B. lanceolatum, tends to appear somewhat later by two or three weeks than the others. Usually, *B. matricariaefolium*, which grows with it and may be confused with it, may be readily distinguished from *B. lanceolatum* in this way.

The other large group, the evergreen grapeferns (*B. alabamense*, *B. biternatum*,[3] *B. dissectum*, *B. multifidum*, *B. oneidense*, and *B. ternatum*), have a markedly different phenology—producing leaves in the summer, maturing spores in the fall, and remaining green until the following summer, when the new leaf develops. The most remarkable species, which in all other respects belongs to the latter group, is *Botrychium lunarioides*. This species, which ranges in the southeastern United States from North Carolina to Florida and Alabama, is unique in appearing only during the winter months. Its leaves just barely start to appear in October, the sterile segments become fully expanded by December and January, and the fertile segments expand in February, the spores being released in March and April. By May the leaves disappear. Thus, phenologically speaking, *B. lunarioides* is in a group by itself.

Obviously, in *Botrychium*, periodicity of leaf production is an important source of taxonomic comparisons. Not all the differences, however, are of a major nature; there are significant minor differences, which when taken together with other characters, bear upon our ideas of species and varietal relationships. For some years we have endeavored to make precise studies of the critical species of this genus, because there have been many controversial interpretations. We now believe, on reasonably substantial grounds (Wagner, 1960b, 1961a), that the four basic species in the northeastern United States differ from each other significantly in time of leaf production. *Botrychium dissectum* (and its bizarre forms) is the last to develop (ca. early June);

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[3]The names of the southeastern botrychia have, unfortunately, been confused rather badly by Underwood, Clausen, and others: The epithet *tenuifolium* Underwood is a synonym of the prior and correct name *biternatum* Savigny. The latter name was incorrectly applied to the plant which should properly be termed *lunarioides* Michaux. (Wagner, 1961c).

B. ternatum is earlier; *B. oneidense* is considerably earlier; and *B. multifidum* starts the earliest (late April, early May). These comparisons are relatively simple to make in the evergreen grapeferns, because the stage of leaf development in any given plant, no matter what its size, can be determined simply by comparing the size of the unrolling new leaf with that of the old, mature leaf from the previous year as a standard (Wagner, 1960b, pp. 309-313). However, it is essential to compare the plants in the same habitats, growing under the same conditions, as Professor W. L. Dix (1945) cautioned us some years ago.

The present paper presents evidence which bears on the interpretations of two infraspecific taxa upon which there has been more or less disagreement since their publication. The first is *Botrychium multifidum* ssp. *typicum* of Clausen (1938)[4] which the author stated to differ from the common eastern American plant in being of medium or small size, 5–25 cm. high (rather than "rather large, 15–42 cm high") and the "ultimate divisions usually somewhat crowded and sometimes overlapping" (rather than "rather remote and not imbricate"). As Weatherby pointed out (1942) the differences of Clausen's subspecies are "exactly the sort of modification one would expect," the large form, which Clausen called "ssp. *silaifolium*" is a modification favored by milder climate and more favorable growing conditions. Most authors have followed Weatherby's view, but continue to recognize the taxon as varietally distinct (Fernald, 1950; Wherry, 1961). Of the larger plant, Fernald (op. cit.) wrote "in the northern half of its range often growing with typical *B. multifidum* and seeming to be merely the larger and older individuals."

The other of the dwarf evergreen grapeferns to be discussed is *B. multifidum* f. *dentatum* R. M. Tryon (1939), stated to differ from the typical form in having finely serrate segments rather than entire segments or segments with rounded teeth. Both "ssp. *typicum*" and "f. *dentatum*" are found in dry fields

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[4]According to our present Code, of course, this would be called ssp. *multifidum*, without author. For convenience, however, in this paper, the original subspecies designation will be used.

or sandy lake shores in the Great Lakes area and New England. Tryon (op. cit.) wrote that his "f. *dentatum* seems to be genetically distinct from the typical form, at least at the type locality," but Clausen (1943) reduced it to synonymy, in spite of the fact that Tryon reported that "there is little or no intergradation" and that the "two plants could be distinguished at a glance by their general aspect."

Regarding these two taxa, there are two questions involved—(1) are "ssp. *typicum*" and "ssp. *silaifolium*" taxonomically justified as separate entities, at least as applied to North American plants; and (2) is "f. *dentatum*" truly distinct genetically, and, if so, what should be its taxonomic interpretation?

METHOD

For comparisons of plants growing together in the same locality, all of the leaves within a continuous and essentially uniform habitat were taken. Blade measurements were taken from 30 dried specimens drawn randomly from the mass collections (unless there were less than 30, in which case all of the leaves were measured). Only collections in which there were 10 specimens or more of *B. multifidum* were used, except for some collections comparing *B. dissectum* and *B. oneidense* only.

For data on relative stage of vernation, given in Tables I and II, the 1961 leaf primordium was measured from its attachment to the rhizome to its tip as described earlier (Wagner, 1960b), and this value was expressed as a percentage of the length of the 1960 leaf of the same plant. In the present work, only *paired* plants of two species were used (cf. Wagner, 1961b). To obtain each pair, a plant of one species was found growing only 20 inches or less from a plant of similar size of the other species; then both plants were dug up.[5] Voucher specimens will be de-

[5] I do not really believe that such meticulousness is necessary, for all the plants in an essentially uniform and continuous environment appear to behave in the same way. However, so that methods used here may be as nearly as possible above reproach, and conform as closely as feasible to a uniform environment, I have followed this rather rigorous rule.

TABLE I. RELATIVE LEAF DEVELOPMENT OF BOTRYCHIUM DISSECTUM AND B. TERNATUM; LENGTH OF THE 1961 LEAF AS OF JULY 2, 1961, GIVEN AS A PERCENTAGE OF THE LENGTH OF THE MATURE 1960 LEAF OF THE SAME PLANT

Paired plants of the two species growing no more than 20 inches apart. Scrubland, ½ mi. S. of M-46, 0.3 mi. W. of Meridian Rd., Gratiot Co., Michigan, July 2, 1961. (Values ranked). Specimen with asterisk possibly injured.

9441. B. DISSECTUM (Average 1960 blade length, 44.9, range 25.0-63.0 mm.)	9442. B. TERNATUM (Average 1960 blade length, 39.5, range 27.0-59.0)
14.18	13.82*
14.90	27.46
18.46	27.92
19.10	29.67
21.93	29.76
25.00	31.40
25.85	33.21
29.61	33.33
32.81	34.75
33.45	42.34
33.81	45.30
38.00	46.66
Average 1961/1960 lf. = 25.59%	Average 1961/1960 lf. = 32.97%

posited in the herbaria of the University of Michigan, Harvard University, and the U. S. National Museum.

BOTRYCHIUM MULTIFIDUM F. DENTATUM

In 1958 I found that there exists in Michigan an evergreen grapefern of medium to large stature which agrees in all respects known to me with the true *Botrychium ternatum* (Thunb.) Sw. of the Old World. Although its leaf blades have much the same plan as that in *B. multifidum*, the segments are slightly more numerous, more angular, and always have definite, though fine, sharp teeth. In typical mesophytic habitats of southern Michigan, the leaf of the American *B. ternatum* averages slightly smaller and more slender than *B. multifidum*. The presence of true *B. ternatum* in the New World was first reported in 1959, and later herbarium and field studies revealed that the plant has a wide range in the area of the St. Lawrence Seaway, from

TABLE II. RELATIVE LEAF DEVELOPMENT OF BOTRYCHIUM MULTIFIDUM AND B. TERNATUM; LENGTH OF THE 1961 LEAF AS OF JULY 5, 1961, GIVEN AS A PERCENTAGE OF THE LENGTH OF THE MATURE 1960 LEAF OF THE SAME PLANT

Paired plants of the two species growing no more than 20 inches apart. Open, dry field, near Twin Lakes, T.27N, R.9W, W. side Sect. 28, Grand Traverse Co., Mich., July 5, 1961. (Values ranked).

9450. B. MULTIFIDUM (Average 1960 blade length, 27.00, range 17.0-39.5 mm.)	9451. B. TERNATUM (Average 1960 blade length, 22.10, range 14.0-40.0 mm.)
63.79	23.08
75.11	23.60
75.37	24.25
76.28	26.77
76.47	26.78
79.73	27.43
81.11	28.05
81.25	31.31
82.65	33.33
82.71	35.84
83.07	38.46
83.78	39.13
85.71	39.24
87.39	39.65
90.09	40.00
90.24	41.27
90.41	42.74
91.07	43.21
92.45	44.70
98.26	47.37
100.00	48.44
101.17	50.91
106.66	51.01
134.90	51.97
1961	1961
Average —— h = 87.90%	Average —— h = 37.44%
1960	1960

Minnesota to Quebec. The initial studies were based largely on shade forms of brushy fields, edges of woods, and old trails in grassy or sedgy sites in dark woods or along wooded streambanks.

As the investigation of *B. ternatum* continued, especially in more northerly areas, smaller and smaller forms were found, these growing in more and more open sites. I suspected then that perhaps the small plant which Dr. Tryon described as *Botrychium multifidum* f. *dentatum* might be an extremely

dwarfed specimen of *B. ternatum*. Examination of herbarium materials sent by Tryon and by Iltis strongly tended to confirm this idea.

Accordingly, to test this idea, and with directions from Dr. Tryon, I went to the type locality at Sand Lake, Douglas Co., Wisconsin, in June, 1959. With Dr. Olga Lakela I explored the area carefully, but the results were most disappointing. Not only were two visits made to the Sand Lake locality, but numerous other possible lakes in the area to the east and south of Solon Springs and Gordon were examined, but entirely without success. At all sites, the shorelines had been radically altered: The water level in the lakes has risen so high since 1938 that all the "shores" except the topmost are now covered, and the old stumps of hundreds of dead jackpines may be seen deep under the water. At this time, therefore, the type locality of *B. multifidum* f. *dentatum* must be considered destroyed, and the growth of botrychia along the lake shores will be curtailed until the original lake levels are resumed. In the fall of 1959, again with directions supplied by Dr. Tryon, I found plants approaching the extreme form of the Sand Lake material in open pastures in Vermont, but no localities were seen that had plants of exactly the same compactness of those of the type locality.

On September 4, 1961, Mrs. Jennie V. A. Dieterle, Herbarium Botanist at the University of Michigan, brought in three grape-ferns she had found near the sandy shores of a small lake in Grand Traverse Co., Michigan. They could not be distinguished from Tryon's original plants. A later survey of the area discovered by Mrs. Dieterle revealed that both *B. multifidum* "ssp. *typicum*" and "f. *dentatum*" were exceedingly abundant there, most of them in the open, sandy, grassy valleys that lead into the lakes, or in depressions where the lakes have dried up and left only shallow, marshy spots. Along the open slopes there are scattered pines, aspens, meadowsweet, sweet-fern, lichens, and mosses, typical plants of sterile soils. The soil is darkened by organic material, but mixed with much sandy mineral matter.

In the most open places, quackgrass, shrubby St. John's-wort, goldenrods, gentians, and ragworts are common. The usual associate of these grapeferns, *B. dissectum,* is extremely rare here.

Apparently the same conditions may be found scattered over a wide area covered by the U. S. Department of the Interior Geological Survey Fife Lake Quadrangle (N-4430-W-8515/15), and we have since found similar localities not only in Grand Traverse Co., but in adjacent Kalkaska Co. as well. The area is strongly recommended to those who wish to study these and other local representatives of the Ophioglossaceae.

Comparison of the new very ample collections from the Fife Lake area no longer leaves any doubt that the plant which Dr. Tryon described from Wisconsin is the extremely dwarfed form of *B. ternatum.* Broadly speaking, the plants of this species from the most northerly areas of Michigan are the smallest (those of the Fife Lake area the smallest we know) and as one progresses southward to the southern tier of counties the plants become larger, culminating in the extremely lax form (illustrated by Wagner, 1959) found in Monroe Co., at the southeast corner of the state (See Table III). Where the two taxa, *B. multifidum* and *B. ternatum*, grow together, all evidence points to their being genetically distinct, and only one apparent hybrid with abortive spores was observed in the Fife Lake area (collection no. 9321X).

Mrs. Dieterle's locality was revisited on July 5, 1961, by the author and F. S. Wagner to determine whether the two taxa are genetically distinct on the basis of comparisons of time of leaf production. Our work elsewhere showed that *B. multifidum* and *B. ternatum* are strikingly different: the former precedes the latter in leaf vernation by at least a month, and the primordial blades are green rather than red. *Botrychium ternatum* is much more like *B. dissectum* in these respects (Wagner 1960b, 1961a), but we were unable to show this critically in the Fife Lake area because of the rarity of *B. dissectum.*

We therefore took the nearest locality known to us to the

TABLE III. COMPARISON OF COLLECTIONS OF BOTRYCHIUM FROM VARIOUS LOCALITIES.

D, M, O, and T = initials of the specific epithets *dissectum, multifidum, oneideuse,* and *ternatum.* Collection no. with numbers of samples in parentheses, with average blade length below.

	D	M	O	T	COMBINED
1. Grand Traverse Co. #1	9317 (1)	9318 (20)	-------	9319 (30)	51
	29.0	**20.8**	------	**25.1**	**23.5**
2. Grand Traverse Co. #2	9320 (2)	9321 (30)	-------	9322 (30)	62
	46.5	**37.4**	------	**39.5**	**38.7**
3. St. Clair Co.	**8394 (14)**	-------	**8393 (19)**	------	33
	44.9	------	**38.0**	------	**40.9**
4. Fletcher, Vermont	9085 (30)	9086 (20)	-------	9087 (5)	55
	45.1	**52.9**	------	**31.4**	**46.7**
5. Midland Co.	9096 (30)	9097 (30)	9098 (1)	9099 (30)	91
	44.9	**57.6**	**60.0**	**39.3**	**47.4**
6. Bristol, Vermont	9080 (30)	9081 (27)	-------	9082 (23)	80
	42.3	**55.0**	------	**37.6**	**45.2**
7. Gratiot Co.	9106 (30)	9107 (17)	-------	9108 (29)	76
	52.8	**52.2**	------	**49.0**	**51.2**
8. Mecosta Co.	9115 (30)	9116 (30)	9117 (18)	9118 (30)	108
	55.0	**69.0**	**51.9**	**47.0**	**52.1**
9. Saginaw Co. #1	8519 (30)	8518 (10)	8517 (30)	8520 (1)	71
	67.3	**53.4**	**61.4**	**62.0**	**62.8**
10. Monroe Co. #1	8631 (30)	-------	8630 (30)	-------	60
	65.3	------	**67.0**	------	**66.1**
11. Monroe Co. #2	9121 (30)	-------	9122 (13)	9123 (30)	73
	65.8	------	**65.9**	**66.7**	**66.2**
12. Saginaw Co. #2	9109 (30)	-------	9110 (30)	-------	60
	75.6	------	**68.4**	------	**72.0**

south, where *B. dissectum* and *B. ternatum* grow in roughly comparable places (Gratiot Co., July 2), and using the method described above, we obtained the data shown in Table I. As previous comparisons have shown, there is a significant average difference between *B. dissectum* and *B. ternatum*, but a strong overlap.

Such was not the case with *B. multifidum* and *B. ternatum* in the Fife Lake area: the two taxa are radically different in periodicity, as shown in Table II. They differed strongly in pigmentation as well—the young sterile blades and spore-bearing parts of *B. multifidum* were bright green, while those of *B. ternatum* were dark bronzy red. (To be sure that the blades and the fertile segments of *B. ternatum* would not turn green at some later stage in vernation, a group of plants was transplanted to Ann Arbor. By the time, July 25-30, that the leaves caught up to those of *B. multifidum* in size, the reddish colors still remained, especially on the blade axes.)

In conclusion, then, "*B. multifidum* f. *dentatum*" seems to be neither a form of *B. multifidum* as Tryon thought it was, nor a synonym of that species, as Clausen thought it was. It is an extremely compact state of *B. ternatum* connected by many intermediates to more lax ecological forms of more shaded and more southerly localities. As such it deserves no name, since the characteristics by which it was considered to differ from *B. multifidum* are those typical of *B. ternatum*. The reasons why it was at first so naturally associated with *B. multifidum* are discussed further below.

BOTRYCHIUM MULTIFIDUM SSP. TYPICUM

In his treatment of this taxon, Robert T. Clausen (1938) stated "where the ranges of the two subspecies [the compact and the lax] overlap, there is complete intergradation between the two forms and it is frequently impossible to place specimens in one category or the other," and that in New England they pass "insensibly" into one another. His area of theoretical overlap includes practically all of northeastern North America and the

Great Lakes area. Nevertheless, he found it possible to place all of the numerous collections he cited in one subspecies or the other.

Botrychium multifidum is able to vary extremely in size, even within a continuous population if that population is spread across a number of habitats. This, of course, is true of practically all species of *Botrychium*. The best demonstration can be shown by a transect passing from an open field into the edge of a woods and then deep into the shade of the woods, where a given species is abundant.

A striking example of extreme forms was found in a locality in Lyndon Township, Washtenaw Co., Michigan (collection no. 8375, April 20, May 5, 1957) where *B. multifidum* is common and scattered through a variety of habitats. All forms, from the most compact to the most lax, occur there, depending on the site; but in one valley, where there is an open grassy horse-trail that passes through low woods, a particularly graphic change occurs. Here, separated by a distance of no more than 10 yards, were plants along the trail, fully fertile, but with compact, pale-green blades only 25–35 mm. long; and plants in deep shade, some of them sterile, with bright green blades 125–140 mm. long. Under the shrubs along the ecotone were plants of intermediate sizes. If I had collected my samples from only the open trail and made herbarium specimens of these, they would unquestionably have been identified as "ssp. *typicum*."

One way of testing the idea that the compact variation of *B. multifidum*, i.e., "ssp. *typicum*," is nothing more than an ecological modification, at least in eastern North America, is to use other species as "controls." Clausen (1943) based the erection of his subspecies in part on the idea that it involves a "genic change." As the other, sympatric species of evergreen grapeferns in northeastern United States tend to grow with it, it should be possible to find "ssp. *typicum*" growing with ordinary-sized individuals of the other species, and thus demonstrate that a "genic change" is really involved. If "ssp. *typicum*" comprises only an ecological modification, on the other hand, the

associated evergreen grapeferns in the community should show the same changes that go with exposed environments, the same compactness that involves smaller stature, more compressed leaf, and increased production of sporangia.

All of the population samplings made during the past several years show clearly that where *B. multifidum* has the characteristics whereby "ssp. *typicum*" is supposed to differ from "ssp. *silaifolium*," the other species associated with it show the same changes. The exceedingly small plants of *B. multifidum* in the most extreme habitats of the Fife Lake area are accompanied by equally compact plants of the associated species, as shown in Table III (collections 9317–9319). These plants of *B. multifidum* were the smallest we have ever found, averaging only 20.75 mm. in blade length. But those of *B. ternatum* also held the record for small size, averaging only 25.13 mm. Across a hill, and down in a deep depression with numerous shrubs, however, the plants of *B. multifidum* were larger (9321), the blades averaging 37.4 mm. in length, and the plants of *B. ternatum* and *B. dissectum* showed a corresponding increase.

Now, taking different collections made through the years, and passing southward across several counties to the south we reach Mecosta, Gratiot, and Saginaw Counties. The plants are still larger, including all the species present at a given site. By the time we reach Monroe Co. at the southeastern corner of Michigan, the plants of corresponding species are over double the size of those from the most exposed sites in Grand Traverse Co. (Table III, 10, 11).

I can thus find no evidence that the compactness of *B. multifidum* as determined by blade length varies independently from that of the associated species. There is no more reason to believe that "ssp. *typicum*" represents a "genic change" in eastern North America than that the dwarfed condition of the associated species represents a "genic change." Taxonomically there appears to be no more reason to designate the dwarfs of *B. multifidum* as a separate subspecies than to treat the dwarfs of *B. ternatum*, *B. dissectum*, or *B. oneidense* as such.

DISCUSSION

The specific distinctness of the plant that Tryon named *B. multifidum* f. *dentatum* would, I believe, have been recognized immediately had not the plants been so dwarfed. As shown in Plates 1 and 2, the compact forms become remarkably similar and their specific characteristics are obscured. If they had been



PLATE 1. COMPACT FORMS OF BOTRYCHIUM MULTIFIDUM (TWO SPECIMENS ON LEFT, NO. 9450) AND B. TERNATUM (TWO SPECIMENS ON RIGHT, NO. 9451) COLLECTED NEAR TWIN LAKES, GRAND TRAVERSE CO., MICHIGAN, IN OPEN, DRY FIELD. PHOTOGRAPH OF LIVING LEAVES.

collected during the earlier stages of vernation I believe that their distinctness from *B. multifidum* would have been much more apparent, as shown here by the figures and data. Tryon's

impression that his plant seemed to be "genetically distinct" from typical *B. multifidum* is now confirmed not only by the constancy of its morphological characters as determined by observations of hundreds of plants in the Fife Lake area of Michigan, but by its sharply different periodicity and pigmentation.

The more controversial interpretation of Clausen's "ssp. *typi-*



PLATE 2. COMPACT FORMS OF BOTRYCHIUM TERNATUM (TOP THREE PLANTS, NO. 9451) AND B. MULTIFIDUM (BOTTOM THREE, NO. 9450) SHOWING DIFFERENT STAGES OF VERNATION OF 1961 LEAF AND THE REMAINING 1960 LEAF, JULY 5, 1961.

cum" needs further attention. Plants which conform in all respects to this "subspecies" may be expected anywhere in the eastern American range of *B. multifidum* wherever the plants grow in extremely exposed sites. At the southeastern end of its New World range (Big Meadows, alt. 3,500 ft., Shenandoah National Park, Madison Co., Virginia, Wagner, 1946) all forms of plants occur, including many which are indistinguishable in size and blade form from plants identified as "ssp. *typicum*" from Minnesota and Canada. Weatherby (1942), Wherry (1942), and others have already questioned Clausen's taxonomic judgment in maintaining *silaifolium* as a subspecies distinct from *typicum*.

The over-all picture in the average geographical variation of *B. multifidum* seems to be one of a latitudinal cline, the smallest plants in the north, the largest in the south—and the whole picture is a sort of magnification of the one that is found in Michigan from north to south. The smallest plants of *B. multifidum* come, on the average, from north of 45°N, and this includes the majority of those from Europe and Canada; the middle sizes center between 40 and 42°N; and the largest are in the south, at roughly 37°N. The most southerly plants that grow near sea-level are in California, and they are the largest known. At Pitkin Marsh, in Sonoma Co., California, I have taken specimens (UC, Wagner 4332), with blades up to 265 mm. long and 430 mm. broad, or 22 times the size of the smallest fertile dwarfed plants from Grand Traverse Co., Michigan. But this is hardly different from the other species of evergreen grapeferns with extensive north-south ranges: *B. dissectum* averages much smaller in Canada, New England, and the northern Great Lakes area than it does in central and southern United States. Another species, *B. biternatum* (syn. *B. tennifolium*) at the northern end of its range in Kentucky, Indiana, and Maryland, averages only one-half or less the stature of the giant, lax plants of coastal South Carolina, Georgia, Mississippi, and Alabama. In both *B. dissectum* and *B. biternatum*, plants may be found

in the southern parts of their ranges that closely resemble those found in the northern parts of their respective ranges, but in both cases, the "northern" types will be found in the most dry, sunny, and sterile places.

It is hoped that the conclusions of this study can be further substantiated by transplant experiments now under way.

LITERATURE CITED

CLAUSEN, ROBERT T. 1938. A monograph of the Ophioglossaceae. Mem. Torrey Bot. Club **19:** 1–177.

———. 1943. Studies in the Ophioglossaceae: *Botrychium*, subgenus *Sceptridium*. Amer. Fern Journ. **33:** 11–27.

DIX, W. L. 1945. Observed characteristics of *Botrychium multifidum* var. *oneidense*. Amer. Fern Jour. **35:** 37–39.

FERNALD, M. L. 1950. Gray's Manual of Botany, 8th ed. American Book Co.

TRYON, R. M., JR. 1939. Notes on the ferns of Wisconsin. Amer. Fern Jour. **29:** 1–9.

WAGNER, W. H., JR. 1946. *Botrychium multifidum* in Virginia. Amer. Fern Jour. **36:** 117–121.

———. 1955. Cytotaxonomic observations on North American ferns. Rhodora **57:** 219–240.

———. 1959. American grapeferns resembling *Botrychium ternatum:* A preliminary report. Amer. Fern Jour. **49:** 97–103.

———. 1960a. Evergreen grapeferns and the meanings of infraspecific categories as used in North American pteridophytes. Amer. Fern Jour. **50:** 32–45.

———. 1960b. Periodicity and pigmentation in *Botrychium* Subg. *Sceptridium* in the northeastern United States. Bull. Torrey Bot. Club **87:** 303–325.

———. 1961a. Some new data on the vernation differences of *Botrychium dissectum* and *B. ternatum*. Amer. Fern Jour. **51:** 31–33.

———. 1961b. Roots and the taxonomic differences between *Botrychium oneidence* and *B. dissectum*. Rhodora **63:** 164–175.

———. 1961c. Nomenclature and typification of two Botrychiums of the southeastern United States. Taxon **10** (6): 165–169.

WAGNER, W. H., JR. AND DALE J. HAGENAH. 1962. *Dryopteris* in the Huron Mountain Club Area of Michigan. Brittonia. **14:** 90–100.

WEATHERBY, C. A. 1942. Subspecies. Rhodora **44:** 157-167.

WHERRY, EDGAR T. 1942. The ferns and lycosphens of Pennsylvania. Bartonia **21:** 11–37.

———. 1961. The fern guide. Doubleday and Co., Garden City, N. Y.

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A Theory of Relationships in the Lycopodium inundatum Complex

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All authors agree that the taxonomic interpretation of the members of the *Lycopodium inundatum* complex is difficult. Even so recently as 1960, Wagner wrote that this group of club-mosses "greatly needs research," and Wherry (1961) stated that "the unravelling of the real relationships in this 'difficult' group is a problem greatly needing attack by combined morphological, physiological, and cytological studies." Practically, the need for a better taxonomic understanding of the group is illustrated by the fact that the plants are hard, and sometimes impossible, to key out in the best manuals. A check of herbarium material will show that many specimens have been named and annotated several times with several different names, many plants have been obviously misnamed, and still others have no name at all. Those who are familiar with these plants under natural conditions recognize that field observations are also puzzling.

This paper is a result of more than a year's study of all the material of the *Lycopodium inundatum* complex represented in the herbaria of the American Fern Society and University of Michigan, plus those living specimens kindly sent for my study by the botanists to be acknowledged below. It is my purpose here to present a hypothesis of relationships among these plants that has emerged from this investigation, and it is my hope to test this hypothesis in future years. I believe that presenting this hypothesis will be of value for other botanists who are dealing with these plants.

Stated briefly, my hypothesis is as follows: There are probably *four good species* which hybridize with each other when they occur together. There is some backcrossing of the hybrids with the parents producing "difficult" intermediates in the populations. This hypothesis is supported by the following facts:

A. Examination of the whole variation pattern in the eastern United States seems to bring out four extremes or "poles"—*L.*

inundatum, *L. adpressum*, *L. alopecuroides*, and *L. prostratum*, as shown in Figure 1.

B. All the other taxa that have been described seem to lie between two of these poles, i.e., are intermediates.

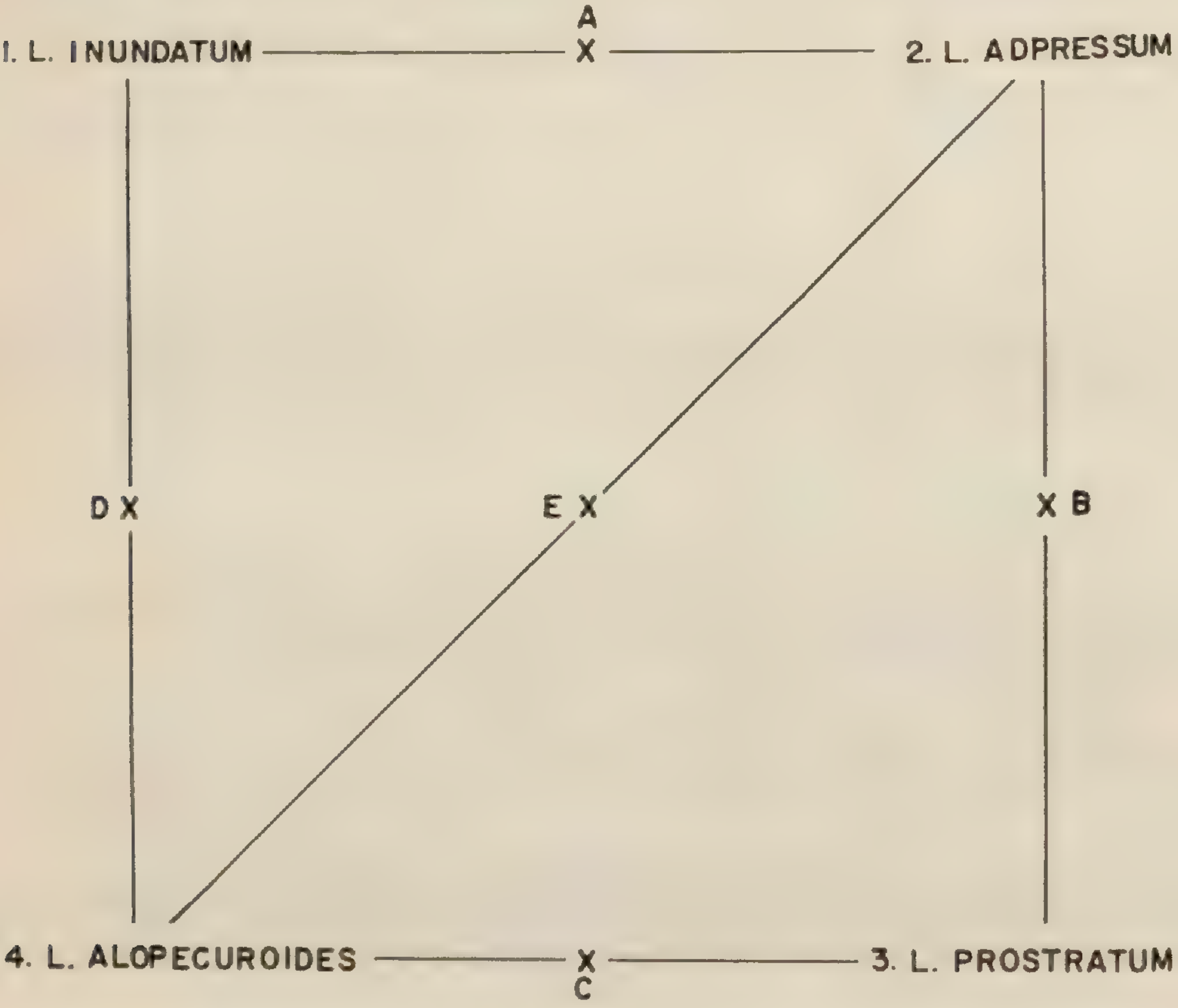


Fig. 1. Four major extremes in the Lycopodium inundatum complex.

I consider the four "poles" as good species because even though they apparently hybridize they maintain, nevertheless, their identities rather than losing their respective individualities. Except for *L. inundatum* and *L. prostratum* which do not grow together, all of the species may be found growing together in the same habitats. Even if the intermediates between the "poles" are more or less fertile, the "poles" remain discrete. The more

or less fertile intermediates between the species are probably the result of introgression, i.e., hybridization and backcrossing (Edgar Anderson, 1949). In the following paragraphs I shall describe the basic species briefly, and then their intermediates.

Although the plants are superficially similar in many respects (Table 1), they differ in the presence or absence of teeth along the leaves of the rhizome and the fertile stalk, the leaf and sporophyll shape and size, the distribution and arrangement of leaves on the rhizome, the fertile stalks and sporophylls, the gross diameter of the fertile stalks and rhizomes, the growth habit of rhizomes, and possibly in anatomical details. One of the most subtle characters, especially on herbarium sheets, has to do with "arching" vs. "prostrate" rhizomes: arching rhizomes are those that curve upward above the soil and then curve downward and root; prostrate rhizomes are those which lie perfectly flat or nearly so on the substratum, often rooting throughout their length. *Lycopodium alopecuroides* seems to show the strongest tendency toward arching, as will be described below, whereas *L. prostratum* tends to grow perfectly flat.

THE BASIC SPECIES

1. LYCOPODIUM INUNDATUM L.

This is the smallest plant in the complex with fertile stalks (including strobili) up to 10 cm. long (rarely longer) and about 3 to 4 mm. wide (including leaves). The leaves of both fertile stalks (excluding strobili) and rhizomes are linear-subulate and *entire*. The rhizomes are arched, with closely grouped leaves which extend upwardly. It is commonly found in *Sphagnum* bogs and wet, sandy places. A northern species, it has been found as far south as West Virginia (Core, 1939), Maryland (Reed, 1953), and southern New Jersey.

2. LYCOPODIUM ADPRESSUM (Chapm.) Lloyd & Underw.

This species is characterized by having long, slender *fertile stalks up to 36 cm. long* and 4 mm. wide, with *entire*, subulate, closely appressed leaves. The sporophylls are appressed. Some rhizome leaves have a few scattered teeth. The fertile stalks are

TABLE 1. COMPARATIVE CHARACTERISTICS OF L. INUNDATUM COMPLEX

	L. inundatum	*L. adpressum*	*L. alopecuroides*	*L. prostratum*
Length of Fertile Stalk	Short: To 10 cm tall.	Long: To 40 cm. tall.	Long: To 25 cm. tall.	Long: To 36 cm. tall.
Teeth on Rhizome Leaves	None: Leaves entire.	Few, teeth scattered.	Abundant.	Very abundant.
Teeth on Fertile Stalk	None: Leaves entire.	None: Leaves entire.	Abundant.	Very abundant.
Habit of Rhizomes: Arched Forms	Tend to bend between yearly rootings.	Arched or prostrate.	Arching between yearly rootings.	Tend to lie flat.
Diameter of Fertile Stalk Below Strobilus	Medium thick: 5–6 mm.; leaves spreading.	Extremely thin: 3–5 mm.; leaves appressed.	Thick: 8–10 mm.; leaves spreading.	Thick: 6–8 mm.; leaves slightly spreading.
Rhizome Leaf Arrangement	Encircling rhizome.	Encircling rhizome.	Encircling rhizome.	Flat in 1 plane, "Feathered."

sometimes branched. This species ranges from New England to Florida and Louisiana.

3. LYCOPODIUM PROSTRATUM Harper

This species seems to be the largest and most robust of the group. The rhizomes grow flat along the ground and bear numerous, many-toothed leaves up to 1 cm. long which are arranged perpendicularly to the stem. The leaf arrangement gives the rhizome a "feathered" appearance. The fertile stalks are up to 36 cm. long (including strobilus) and bear numerous closely appressed leaves with many teeth. The strobili are up to 15 cm. long. Although its range is not well understood according to McVaugh and Pyron (1950), Small (1938) says it extends in the Coastal Plain from North Carolina to Louisiana.

4. LYCOPODIUM ALOPECUROIDES L.

This species has stout rhizomes and fertile spikes. The rhizomes are densely covered with toothed leaves, these more closely arranged than in *L. prostratum,* giving it a rounded, fuzzy appearance. The leaves of both fertile stalks and rhizomes bear numerous teeth. Where they touch the ground, the rhizomes root. The fertile stalks arise from the rhizomes and are up to 20 cm. long (including strobili). Although seemingly wholly distinct from each of them, the species seems to be generally intermediate between *L. adpressum* and *L. prostratum.* It ranges from Texas to Florida and New England.

THE INTERMEDIATES

A. LYCOPODIUM ADPRESSUM × INUNDATUM.

Lycopodium inundatum var. *bigelovii* Tuckerman, which looks like a large form of *L. inundatum* with somewhat scattered leaves giving it a "shaggy" appearance probably originated as a hybrid between *L. adpressum* and *L. inundatum.* Close examination of the leaves of the rhizome will reveal some teeth on some leaves. The fertile stalks, which are up to 20 cm. long (including strobilus), are *strikingly* slender with more or less entire leaves. More field work is needed before the relationships of this plant are fully understood. It ranges from New England to New Jersey, and in the mountains to Virginia.

B. LYCOPODIUM ADPRESSUM × PROSTRATUM.

This is an uncommon but distinct hybrid. Fertile stalks are up to 35 cm. long and slender with more or less spreading, many-toothed leaves . The rhizomes have a perpendicular leaf arrangement which gives the plant a "feathered" appearance but the leaves are generally closer together than in *L. prostratum*. The specimens that have been examined have been collected well within the known range of both parents.

C. LYCOPODIUM ALOPECUROIDES × PROSTRATUM.

Although McVaugh and Pyron (1950) indicate that *L. alopecuroides* and *L. prostratum* do not seem to hybridize, some specimens examined in the American Fern Society Herbarium look like unusually large specimens of *L. alopecuroides* with ascending, somewhat spreading leaf arrangement on the fertile stalks. The rhizome leaves are perpendicular and with a "feathered" arrangement. This is not a proved hybrid but since *L. alopecuroides* is very closely related and similar to *L. prostratum*, such a hybrid is to be expected. The range is not known.

D. LYCOPODIUM ALOPECUROIDES × INUNDATUM.

There are some plants in the Fern Society Herbarium that look like both *L. alopecuroides* and *L. inundatum* in some respects. The fertile stalks have loosely arranged leaves with numerous teeth. The leaves of the rhizomes are crowded and bear teeth. The plants are intermediate in size between the possible parents. The range of this hybrid is not known.

E. LYCOPODIUM ADPRESSUM × ALOPECUROIDES.

This is probably the origin of *L. inundatum* var. *elongatum* Chapman, and *L. inundatum* var. *robustum* Eaton may be another form of it. This plant is commonly found in the New Jersey Pine Barrens and vicinity and has the general appearance of a "fat" and somewhat shorter form of *L. adpressum*. Close examination of this plant shows that it has arched stems, closely arranged leaves along the rhizome with numerous teeth (but fewer than in *L. alopecuroides*). The fertile stalks have weakly appressed to more or less spreading leaves, and some bear a few teeth (unlike *L. adpressum* which has no teeth along the fertile

stem leaves). The fertile stalks are up to 25 cm. long. The leaves are more spreading than in typical *L. adpressum* but less so than in *L. alopecuroides.*

The proper relationship of *L. inundatum* var. *elongatum* is not fully understood. The characters seem to indicate that it is a hybrid between *L. adpressum* and *L. alopecuroides.* One collection sent to me by Dr. Kenneth A. Nicely collected from along U. S. Route 117, 9 miles north of Rose Hill, Duplin County, North Carolina, was very confusing until it was realized that there were three entities mixed in the collection—*L. adpressum, L. alopecuroides,* and what clearly appears to be a hybrid. The plants were so closely intertangled that they had to be carefully pulled apart before it was fully realized that they were separate plants. A second collection sent to me by Dr. Edgar T. Wherry was collected at Mud Lake, near Mountville, Lancaster County, Pennsylvania. Again three entities were involved—*L. adpressum, L. inundatum,* and apparently the same hybrid. Dr. Wherry also indicated that the "impression one gets is certainly that of two species and their hybrid" (personal communication). All three of these collections have been planted at the University of Michigan Botanical Garden and are being studied further. Dr. Wherry also sent a bit of soil containing a "Duke's Mixture" of all three of these plants growing together. This does, indeed, suggest the possibility that these are parents and their hybrid. Present indications suggest that Wherry's "var. *elongatum*" is not a cross between the *L. adpressum* and *L. inundatum* but possibly between *L. adpressum* and *L. alopecuroides,* since what Wherry calls the "so-called var. *elongatum*" is somewhat more robust ("thicker") than either *L. adpressum* or *L. inundatum* and that it, unlike either "parent," has teeth on the leaves of the fertile stalk.

It seems possible that two sets of parents could each hybridize to produce hybrids that look very much like each other (maybe the basic difference between the so-called "var. *elongatum*" and "var. *robustum*"). In this case, the plant that I now consider *L. adpressum* × *inundatum* (the so-called *L. inundatum* var. *bigelovii*) would likely be a trihybrid cross between *L. adpressum*

and the hybrid *L. adpressum* × *inundatum*. Much more field study is needed before the exact relationships of these plants are resolved. The range or ranges are not known.

In conclusion, to repeat the hypothesis that I have presented here, there seem to be four basic species and a series of intermediates present in the *Lycopodium inundatum* complex. Five different hybrid combinations are postulated. However, it seems possible that the situation may actually be more complicated by the occasional occurrence of trihybrid introgressant populations (e.g., the forms of the so-called *L. inundatum* var. *bigelovii* mentioned above).

The author wishes to thank all those who have so graciously assisted in this study. To those who so willingly assisted in obtaining material—Drs. Louis Hand, James Hardin, K. A. Nicely, Edgar Wherry, Erdman West, E. S. Ford, D. B. Ward, John Price, Miss Lena Artz, and Miss Dorothy Evert, thanks is hereby expressed. Special thanks hereby are given to Dr. W. H. Wagner, Jr., under whose suggestion this study was initiated and who has been most helpful in his criticisms and suggestions.

BIBLIOGRAPHY

ANDERSON, EDGAR. 1949. Introgressive Hybridization. John Wiley and Sons, New York.

CORE, EARL L. 1939. Notes and News. Gum Springs Bog. Castanea 4: 7-8.

FERNALD, M. L. 1950. Gray's Manual of Botany, 8th ed. American Book Co., New York.

MCVAUGH, ROGERS, AND JOSEPH H. PYRON. 1950. Ferns of Georgia. Univ. of Georgia Press, Athens.

REED, CLYDE F. 1953. The Ferns and Fern Allies of Maryland and Delaware Including District of Columbia. Reed Herbarium, Baltimore.

SMALL, JOHN KUNKEL. 1938. Ferns of the Southeastern States. Science Press, Lancaster, Pa.

WAGNER, WARREN H., JR. 1960. Evergreen Grapeferns and the Meanings of Intraspecific Categories as Used in North American Pteridophytes. Amer. Fern Jour. 50: 32-45.

WHERRY, EDGAR T. 1961. The Fern Guide. Doubleday and Co., Garden City, New York.

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Another Name Change for the Florida Fern Known as Dryopteris setigera

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In 1941, I published in the Journal[1] a brief paper entitled "On the Florida Fern Known as *Dryopteris setigera*," in which I noted that according to C. Christensen's Index Filicum, Supplementum III (1934) and the best information available at the time, the correct name for the naturalized fern in Florida called *Dryopteris setigera* was *Dryopteris uliginosa* (Kunze) C. Chr. It now appears that this name is no longer tenable on two counts: It is a later homonym (dating from 1934) of *Dryopteris uliginosa* (A. Braun ex Doell) Druce (1908)[2] and secondly an earlier specific epithet has been found in *Polystichum Torresianum* Gaud. (1828), the epithet *uliginosa* Kunze dating only from 1847.

There is a further point, that regarding the correct generic name. In 1941 I was following Christensen in recognizing an inclusive genus *Dryopteris*, but information has accumulated since that time that indicates that all of these plants are not closely allied; some authors have even proposed that the thelypteroid group be separated into a different family from *Dryopteris sens. strict.* I agree at least to the extent of separating *Dryopteris sens. strict.* (as typified by the male fern, *D. Filix-mas*) from *Thelypteris sens. lat.*

W. H. Wagner, Jr., was the first to identify *Polystichum Torresianum* with *Dryopteris uliginosa* (Kunze) C. Chr.[3] He did not see the type of *Torresianum* and apparently no one else has examined it, but the original description agrees except for the statement that the hairs are sometimes branched; as Wagner points out, this was probably an error of observation, because branched hairs would hardly be found in any species of the type

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[1]THIS JOURNAL **31**: 12–14. 1941.

[2]For synonmy see "The Correct Name for the Hybrid *Dryopteris cristata* × *spinulosa*" by F. Ballard, THIS JOURNAL **50**: 105, 106. 1960.

[3]"Pteridophytes of Guam," Occ. Pap. Bernice P. Bishop Mus. **19**: 58. 1948.

described. The original of *P. Torresianum* came from Guam, an island having a relatively small fern flora, in which there is no species that could agree other than *D. uliginosa.* Therefore, it may be accepted even in the absence of a study of the type that *Torresianum* is conspecific with *D. uliginosa,* as that is represented in Guam.

Wagner adopted the name *Lastrea Torresiana* (Gaud.) Moore, following Copeland in using the generic name *Lastrea.* However, *Lastrea* is a synonym of the earlier *Thelypteris*; a proposal to conserve *Lastrea* in the sense of Copeland was rejected by the International Committee on Nomenclature, Pteridophyta, and therefore *Thelypteris* remains correct. The transfer of *P. Torresianum* to *Thelypteris* was recently made by Alston. The pertinent synonymy of the Florida fern is therefore as follows:

THELYPTERIS TORRESIANA (Gaud.) Alston, Lilloa **30:** 11. 1960.

Polystichum Torresianum Gaud. in Frey. Voy. Bot. Uranie 333. 1828.

Aspidium uliginosum Kunze, Linnaea **20:** 6. 1847.

Lastrea Torresiana Moore, Ind. Fil. 86. 1856.

Dryopteris uliginosa C. Chr. Ind. Fil. Sup. **3:** 100. 1934, non Druce (1908).

Thelypteris uliginosa Ching, Bull. Fan Mem. Inst. Biol. **6:** 342. 1936.

Dryopteris setigera auctt. non Kuntze (1891).

The true *Dryopteris setigera,* or as it should be called now *Thelypteris setigera* (Blume) Ching,[4] is a species of Asia and Malesia, apparently rare; it is probably not in cultivation or naturalized anywhere. A synonym of it is *Dryopteris ornata* (Wall, ex Hook.) C. Chr. as delimited by Maxon.[5] It differs from *T. Torresiana* in several ways, especially in having abundant narrow pale scales on the rhachises, rhachillas, and costae, and even on the costules. When they fall from the rhachises and stipes, these scales leave a small, somewhat spine-like tubercle or pro-

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[4] Bull. Fan Mem. Inst. Biol. **6:** 345. 1936.
[5] Proc. Biol. Soc. Washington **36:** 171, 172. 1923.

tuberance, which is probably what caused Backer and Posthumus[6] to suggest that the original *Cheilanthes setigera* Blume was a *Hypolepis*. Blume's original reference of the species to *Cheilanthes* was occasioned by the fact that the margins of the segments are recurved and somewhat cover the sori. I have studied and photographed the type of *C. setigera* (Morton Photograph 1294) in the Rijksherbarium Leiden; it is certainly not a *Cheilanthes* nor a *Hypolepis* but a *Thelypteris*, as stated above the one later called *Dryopteris ornata*.

SMITHSONIAN INSTITUTION, WASHINGTON 25, D. C.

[6] Varenflora voor Java 42. 1939.

A Resume of the Taxonomic Reorganization of Equisetum, Subgenus Hippochaete, II

RICHARD L. HAUKE

A. Section **Incunabula** Hauke, sect. nov.

"*Hippochaete* A. *Equiseta pleiosticha*" Milde, Mon. Equis. 172. 1867 (Invalid).

"*Equisetum* sect. 2. *Hippochaete* A. *Equiseta pleiosticha*" Milde, Fil. Eur. 230. 1867 (Invalid).

"*Equisetum* sect. *Equiseta Primitiva*" Schaffn. Amer. Fern Journ. **11**: 68. 1921 (Invalid).

Plantae caulibus longis sempervirentibus, verticillis ramorum regularibus, stomatibus in lineis tribus aut quattuor positis, et endodermidibus singularibus praeditae. Gametophyta monoeca. Species typica: *Equisetum giganteum* L.[1]

Section *Incunabula* contains only *E. giganteum*, which is described below. The names given to this section by both Milde and Shaffner are invalid under Article 21 of the International Code of Botanical Nomenclature (Lanjouw, J. *et al.*, 1956), being in a binomial form instead of a single epithet. It is even doubtful whether either man intended to use the taxonomic cate-

[1] The Latin description was prepared by Dr. Roger A. Pack, Department of Classical Studies, University of Michigan.

gory of section. Milde retained the same subdivisions under *Hippochaete*, whether he considered that taxon to be a genus or a section. Schaffner (1921, p. 68) stated: "The distinctions [between *Equisetum* and *Hippochaete*] are not sharp enough for two subgenera or sections. . . . One can make a number of subsections but these are too closely allied, according to the writer's opinion, to be established as subgenera." Consequently, it has been necessary to supply a new name for this section. The epithet *Incunabula* (Latin neuter noun meaning origin) refers to the primitive nature of *E. giganteum*.

1. EQUISETUM GIGANTEUM L. Sp. Pl., ed. 2, 1517. 1763.

   E. pyramidale Goldm. Nova Acta Acad. Leop.-Carol. **11**: 469. 1843.

   E. xylochaetum Mett. Fil. Lechler. **2**: 34. 1859.

   E. martii Milde, Verh. Zool.-Bot. Ges. Wein **12**: 1258. 1862.

Equisetum giganteum has tall, evergreen stems bearing regular whorls of branches and having the stomata in bands of three or four lines on each side of the grooves; it is further distinguished by having individual endodermises and gametophytes which are predominantly bisexual when cultured. The sheaths of this species are light brown, about as long as wide, flare slightly upward, and usually retain their teeth. The carinal collenchyma is well-developed.

This species is found in Cuba, Jamaica, Hispaniola, and Central and South America. It grows along rivers or in swampy places, at altitudes of 150 to 2,600 meters. I have seen no specimens from Mexico. *Equisetum giganteum* is quite uniform in the Caribbean area, less so in Brazil, Argentina, and Central America, and most diverse in central South America. In Peru and Brazil the sheath teeth are sometimes firm and woody, and plants with extremely woody teeth have been named *E. xylochaetum*.

B. Section **Ambigua** (Farw.) Hauke, comb. nov.

   "*Equisetum* II. *Sclerocaulon* a. *Annua*" Döll, Flora des Grossherz. Baden **1**: 66. 1857.

"*Equisetum* sect. 2. *Hippochaete* B. *Equiseta ambigua*" Milde, Fil. Eur. 234. 1867 (Invalid).

"*Equisetum* sect. 2. *Hippochaete C. Equiseta monosticha*" Milde, l.c. (*pro parte*).

Hippochaete sect. *Ambigua* Farw. Mem. N. Y. Bot. Gard. **6**: 464. 1916.

"*Equisetum* sect. *Equiseta Ambigua*" Schaffn. Amer. Fern Journ. **11**: 68. 1921 (Invalid).

"*Equisetum* sect. *Equiseta Hiberna*" Schaffn. l. c. (*pro parte*).

Plantae e caulibus longis constantes qui verticillos ramorum ordinatos, stomata in lineis singulis posita, et endodermidem duplicem communem habent; aut caules nunc longi nunc medii, sine regula ramosi, stomata in linea una aut lineis duabus tribusve posita, et endodermides singulares aut endodermidem duplicem communem habentes; aut caule longitudinis mediae, non ramoso, stomata in lineis singulis et endodermidem duplicem communem habentes. Gametophyta dioeca. Species typica: *Equisetum laevigatum* A. Braun.

Because of the diversity of characters included, this section is difficult to characterize. Despite this variation in appearance, the species herein included all intergrade and their hybrids with *E. hyemale* have a similar appearance.

Milde's group "*Equiseta ambigua*" included *E. ramosissimum*, and the name referred to the variable stomatal arrangement of that species. Section *Ambigua* of Farwell was so named because of the deciduous stems and blunt cones of *Equisetum laevigatum*, one of the species it contained. It is odd that both Milde and Farwell should have used the term "*Ambigua*" but with reference to different characteristics of different species, and yet that the type species of each author's group should, in my opinion, be included in the same section.

2. EQUISETUM RAMOSISSIMUM Desf.

This species ranges throughout the eastern hemisphere from the Cape of Good Hope to Lithuania, and from the Azores to Fiji. It comprises two well-defined taxa, subsp. *ramosissimum* and subsp. *debile*, which have been traditionally considered as separate species, but which are here treated as subspecies because they intergrade completely along their zone of contact and inter-

mediate forms are wholly fertile. In their usual forms, however, the two are different in several characters and the number of intermediates is relatively low.

2a. EQUISETUM RAMOSISSIMUM Desf. subsp. RAMOSISSIMUM

E. ramosissimum Desf. Fl. Atlant. **2**: 398. 1800. [July, 1799].

E. elongatum Willd. Sp. Pl. **5**: 6. 1810.

E. sieboldi Milde, Ann. Mus. Bot. Lugd. Batavi **1**: 62. 1863.

The aerial stems are generally tall and irregularly branched; and evergreen or, in colder climates, dying back in the fall. The stomata are in bands of 1 to 3 lines, the sheaths are much longer than wide, and the sheath teeth, or at least their bases, usually persist. In cross-section the stem has a double common endodermis.

Subsp. *ramosissimum* is extremely wide ranging, from South and East Africa through Madagascar and Mauritius, Mediterranean Africa, the Canary Islands and the Azores, to southern Germany, Czechoslovakia and Lithuania, and east through the Balkans, Asia Minor, Transcaucasia and north of the Caspian Sea to Sinkiang, Mongolia, Korea, and Japan, and south to northern India, Tibet, central China, and Formosa.

The variability of subsp. *ramosissimum* is attested to by the great number of varieties that have been named. Milde described 12 from Africa alone. There are, however, no abrupt discontinuities in the variation, and none of the named varieties seems defensible.

Deformed stems of *E. giganteum*, *E. myriochaetum*, and *E. laevigatum*, may closely resemble deformed stems of this subspecies, and it is because of this that *E. ramosissimum* has been attributed erroneously to America.

Subsp. *ramosissimum* hybridizes with *E. hyemale* to produce *E.* × *moorei*. The great resemblance of *E.* × *moorei* to *E.* × *ferrissii*, the hybrid between *E. laevigatum* and *E. hyemale*, attests to the close affinity of *E. laevigatum* and *E. ramosissimum*. It also appears to hybridize with *E. variegatum* in a limited area in the Alps.

2b. EQUISETUM RAMOISSIMUM Desf. subsp. **debile** (Roxb.) Hauke, comb. nov.

E. debile Roxb. ex Vauch. Mon. Prêles 387. 1821.

This subspecies has tall, irregularly branched, evergreen stems with stomata in single lines, one on each side of each groove. The sheaths are slightly longer than wide, and the teeth break off, leaving a truncated margin on the sheath. The stem has the individual endodermal arrangement, like that of *E. giganteum*.

Subspecies *debile* is found in southeastern Asia from India and Nepal to Burma, southern China and Formosa, and throughout Indochina, the Philippine Islands, Indonesia, New Guinea, New Hebrides, and New Caledonia to Fiji. It has always been regarded as a distinct species, though Baker (according to Schaffner, 1931) considered it doubtfully distinct from *E. ramosissimum*, and Schaffner himself said: "on the geographic transition it seems impossible to tell imperfect specimens apart, so there is nothing left to do but to draw the geographic line and name the specimens accordingly." Because "typical" *E. debile* is differentiated from "typical" *E. ramosissimum* by so many characters—short, smooth cylindric, truncated sheaths, individual endodermises around each vascular bundle, and stomata in only one line—I consider it a subspecies rather than a variety.

Equisetum ramosissimum approaches *E. myriochaetum* in general appearance, but differs in endodermal pattern, and it does not attain the large size of the latter species, nor have as regular whorls of branches.

3. EQUISETUM MYRIOCHAETUM Schlecht. and Cham. Linnaea **5**: 623. 1830.

The tallest of all *Hippochaete*, *E. myriochaetum* may have stems up to 8 meters tall. They are evergreen, bear regular whorls of branches, have stomata in single lines, and have a double common endodermis. The carinal and vallecular collenchyma are about equal. The sheaths are slightly elongated, but are appressed to the stem and appear smooth and cylindrical. The branch ridges bear silica tubercles which, unlike those of any other species, look like sawteeth when viewed laterally.

This species grows in Mexico, Central America, Colombia, Ecuador, and Peru; it is found in swampy places, or along rivers and streams.

In general appearance, *E. myriochactum* resembles *E. giganteum* and is often confused with it, but the two species are really quite different when all characters are taken into account. The existence of a sterile hybrid, *E.* × *schaffneri,* between these two species substantiates their specific identity. Similar to *E. laevigatum* in many characters other than size and branching, *E. myriochaetum* also hybridizes with *E. hyemale* var. *affine,* and this hybrid looks like *E.* × *ferrissii,* the hybrid between *E. laevigatum* and *E. hyemale* var. *affine.*

4. EQUISETUM LAEVIGATUM A. Br. Amer. Jour. Sci. **46**: 87. 1844.
   E. funstoni A. A. Eat. Fern Bull. **11**: 10. 1903.
   E. kansanum Schaffn. Ohio Nat. **13**: 21. 1912.
   E. fontinale Copel. Madroño **3**: 367. 1936.
   E. laevigatum subsp. *funstonii* (A. A. Eat.) Hartman, Trans. Kansas Acad. Sci. **61**: 144. 1958.

The smooth scouring rush is aptly named, for it has a thin texture and little silica. The stems, unbranched and of medium height, die back in autumn, except in the Southwest. The sheaths of this species are usually green, are about twice as long as wide, and broaden gradually from base to apex. In late summer the sheaths may become ashy grey, mimicking those of *E. hyemale.* The cones of *E. laevigatum* have blunt or acute apices, rather than apiculate, as is usual in *Hippochaete.* The vallecular collenchyma equals or even exceeds the carinal collenchyma.

Ranging from Michigan and Ontario, west to British Columbia, and south to Ohio, Indiana, Missouri, Oklahoma, Texas, northern Mexico, and Baja California, *E. laevigatum* is to be found predominantly in open, moist places with sandy soil. In the southwestern part of its range, perhaps because of the absence of winterkill, *E. laevigatum* tends to be coarser-stemmed, and to have greater development of the carinal collenchyma. Here it also has slightly apiculate cones. This form, named *E. funstonii,* seems to have no genetic basis, for it is found throughout the range of *E. laevigatum* as an injury response. With its

smooth stems and blunt cones, this species might be easily mistaken for *E. fluviatile,* but the deciduous sheath teeth and the stomata in single lines quickly identify it.

The deciduous character of *E. laevigatum* is found also in *E. ramosissimum* subsp. *ramosissimum* in Europe, an affinity further demonstrated by the great similarity of the hybrids each makes with *E. hyemale, E.* × *ferrissii* and *E.* × *moorei* respectively. *Equisetum laevigatum* also hybridizes with *E. variegatum* to produce *E.* × *nelsonii.*

Much confusion has surrounded the correct application of A. Braun's name *E. laevigatum.* Specimens collected by George Engelmann in August, 1843, from the banks of the Mississippi River below Jefferson Barracks have usually been regarded as the type, but according to the original description it was first discovered by N. Riehl in 1840. An indication that Engelmann had already read Braun's manuscript when he collected his specimens is to be found on the field label of a specimen collected in August, 1843 (MO 1,314,226), on which he wrote "*robustum?,*" struck it out, and wrote "Junges *laevigatum.*"

The New York Botanical Garden Herbarium has a specimen—"Bords immediates du Mississippi, St. Louis, Missouri, Juin, 1840, *N. Riehl* 279"—which was formerly in the Meissner herbarium, where A. Braun could have seen it. I choose this as lectotype for *E. laevigatum* A. Braun. A duplicate of Riehl's collection is in the Naturhistorisches Museum in Vienna. In another paper (Hauke, 1960), I have discussed the misuse of this name by Schaffner and other workers.

LITERATURE CITED

HAUKE, R. L. 1960. The Smooth Scouring Rush and Its Complexities. Amer. Fern Journ. **50:** 185–193.

LANJOUW, J, *et al.* 1956. International Code of Botanical Nomenclature. Utrecht.

SCHAFFNER, J. H. 1921. North American Species of *Equisetum* North of Mexico. Amer. Fern Journ. **11:** 65–75.

———. 1931. Studies of *Equiseta* in European Herbaria. *op. cit.* **21:** 90–102.

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Chromosome Numbers in Some Himalayan Species of Vittaria

S. S. BIR

Vittaria J. E. Smith, the type genus of the family Vittariaceae, according to Beddome (1892) is represented by only four species in India, but his is by no means a complete listing, because as as many as seven species have been collected by the writer from the Sikkim-Darjeeling Himalayas alone. These are *V. himalayensis* Ching, *V. ophiopogonoides* Ching, *V. Doniana* Mett., *V. elongata* Swartz, *V. flexuosa* Fée,[1] *V. sikkimensis Kuhn*, and *V. scolopendrina* (Bory) Thwaites. The first three species mentioned above are additions to Beddome's list for the Himalayas. Of these, *V. himalayensis* and *V. Doniana* are endemic in the Eastern Himalayas. Except for *V. scolopendrina*, all of these are quite common in the area. Nearly all have grass-like leaves and are taxonomically difficult because of the narrow and minute specific differences. A taxonomic account will be published elsewhere.

MATERIALS AND METHODS

Vittarias are exceptionally difficult cytologically owing to the profusion of paraphyses which cannot be separated readily from the sporangia. These globular paraphyses greatly impede the proper flattening and adhesion to the slide of spore-mother-cells, which wash away while the slide is being made permanent. The meiosis has been studied in three of the Himalayan species following the usual acetocarmine squash method. The modified Carnoy's Fluid (1 part acetic acid, 3 parts absolute alcohol and 4 parts chloroform) gives better results than 1 to 3 acetic alcohol, as it helps to clear the spore-mother-cells of stored food materials.

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[1] This species was included by Hooker and Baker (1874) and Beddome (1892) under *V. lineata* (L.) J. E. Smith, a tropical American species and the type of the genus. Fée (1851-52) separated the Indian plant under the name of *flexuosa*. In *V. lineata* the midrib is not raised as in *V. flexuosa* and the scales are more strongly toothed.

OBSERVATIONS

Vittaria himalayensis and *V. flexuosa* are high altitude ferns and are met with between 8,000 and 10,000 feet, whereas *V. ophiopogonoides* is the commonest species of the genus between 4,000 and 6,000 feet elevation. These three species belong to the Euvittaria group of Benedict (1911), characterized by the dorsiventral rhizome and distichous leaves. In all of these three species the sori are present in an extra-marginal groove. The present observations are summarized in the following table:

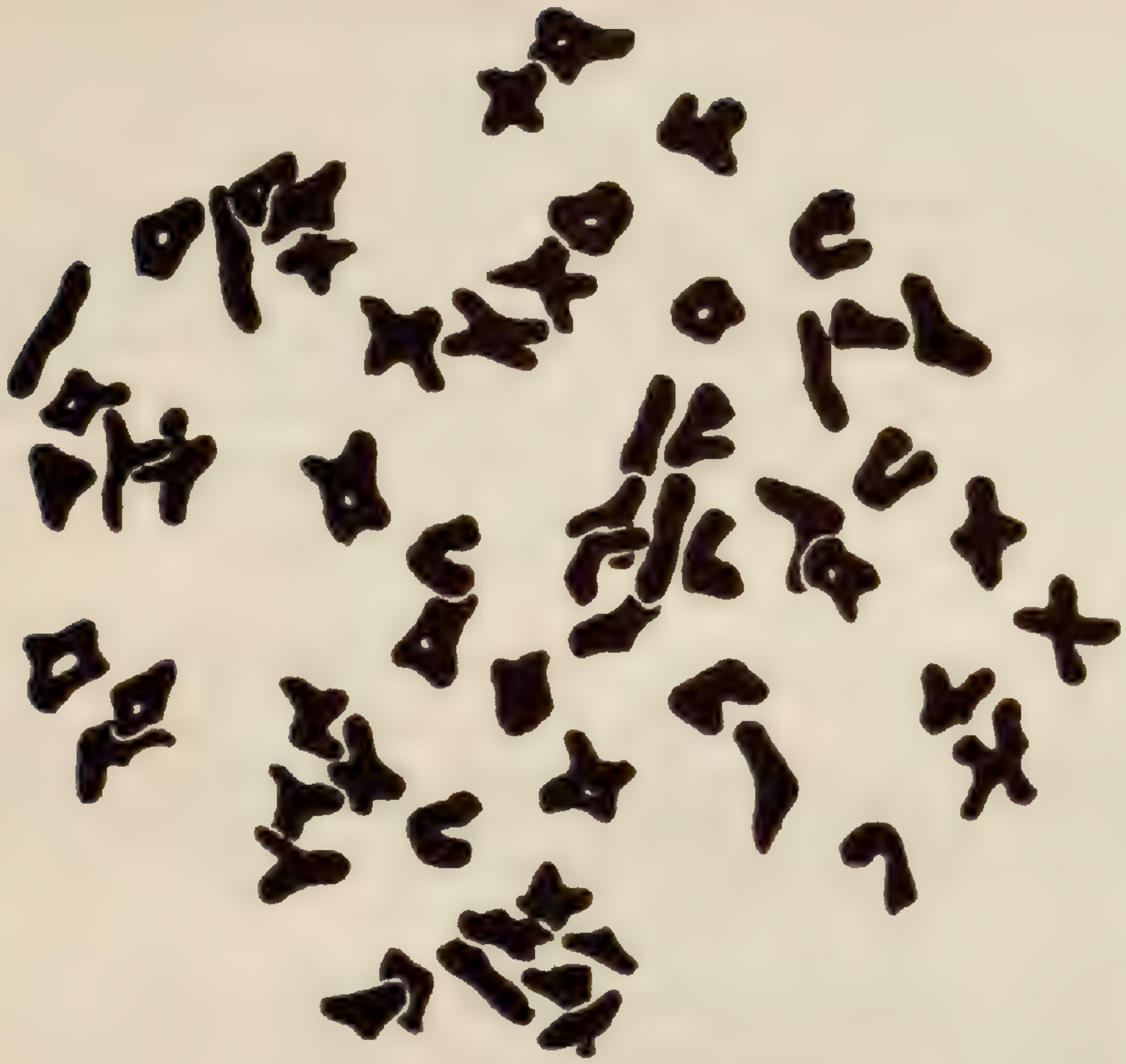
Name	Locality	Chromosome Number[2] *n*	*2n*	Polyploidy
V. himalayensis	Tonglu, 10,000 ft., Darjeeling and Lachen, 8,000 ft., North Sikkim	60 (Fig. 1)		Tetraploid
V. flexuosa (=*V. lineata* of Beddome, 1892)	Tonglu-Sandakphu road, 8,000 ft., Darjeeling	60 (Fig. 2)	120	Tetraploid
V. ophiopogonoides	Lebong, 5,000 ft., Darjeeling and Chungthang, 6,000 ft., North Sikkim	60 (Figs. 3, 4)	120	Tetraploid

[2]The somatic number has been counted from tapetal or archesporial cells of the sporangium.

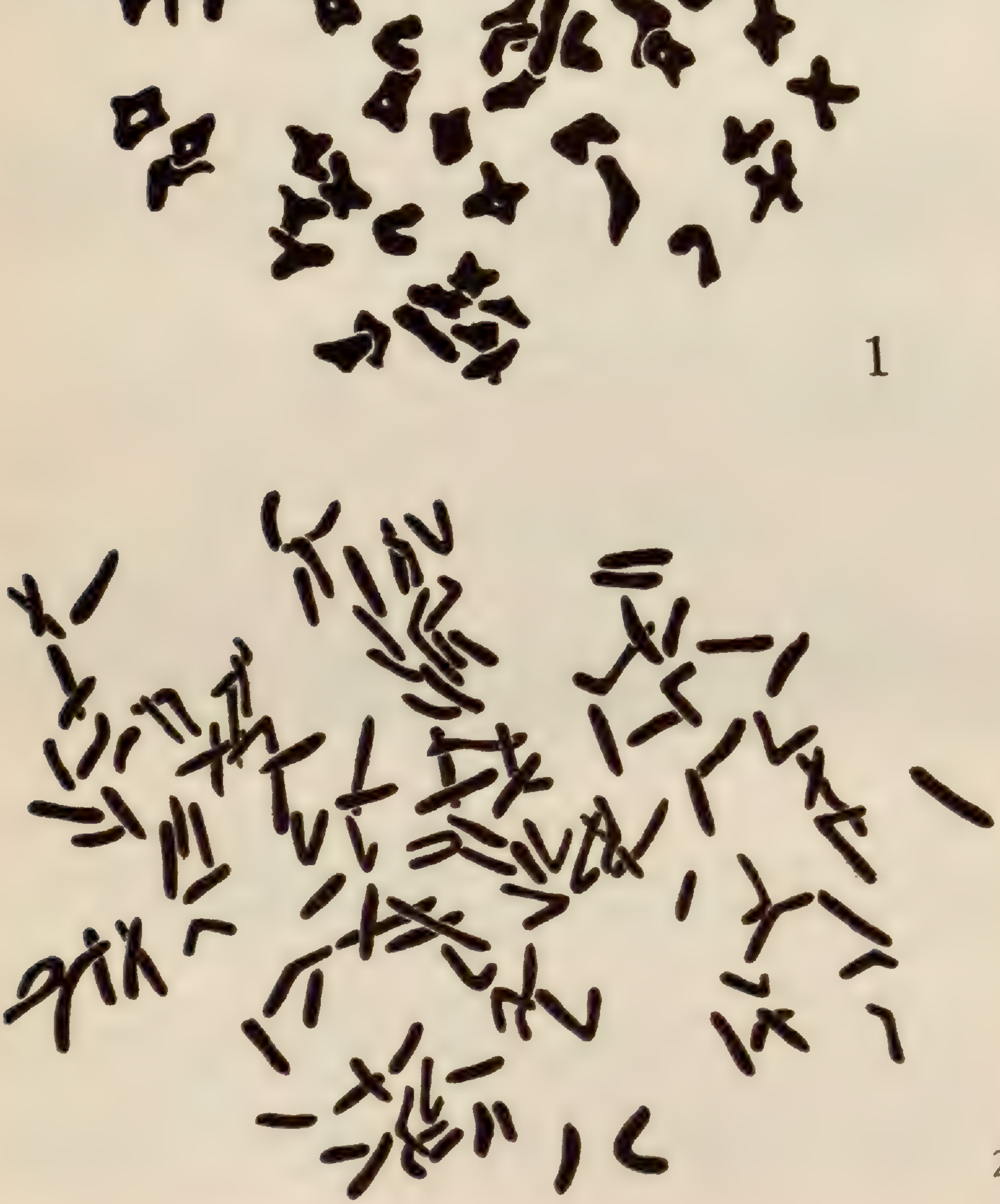
The course of meiosis is perfectly regular, resulting in the production of normal, bilateral, non-perisporiate spores.

DISCUSSION

So far, cytological information is available for only two species of the genus in other regions. Manton and Sledge (1954) reported $n=60$ and $n=120$ for *V. scolopendrina* (Bory) Thwaites (tetraploid) and *V. elongata* Swartz (octoploid) from Ceylon. It speaks very well for a higher grade of polyploidy in the tropics as compared with the Himalayan species growing in a temperate climate. Although no diploid species ($n=30$) has been reported so far, the genus can convincingly be considered to have $x=30$ as a basic number particularly because two other vittarioid



1



2

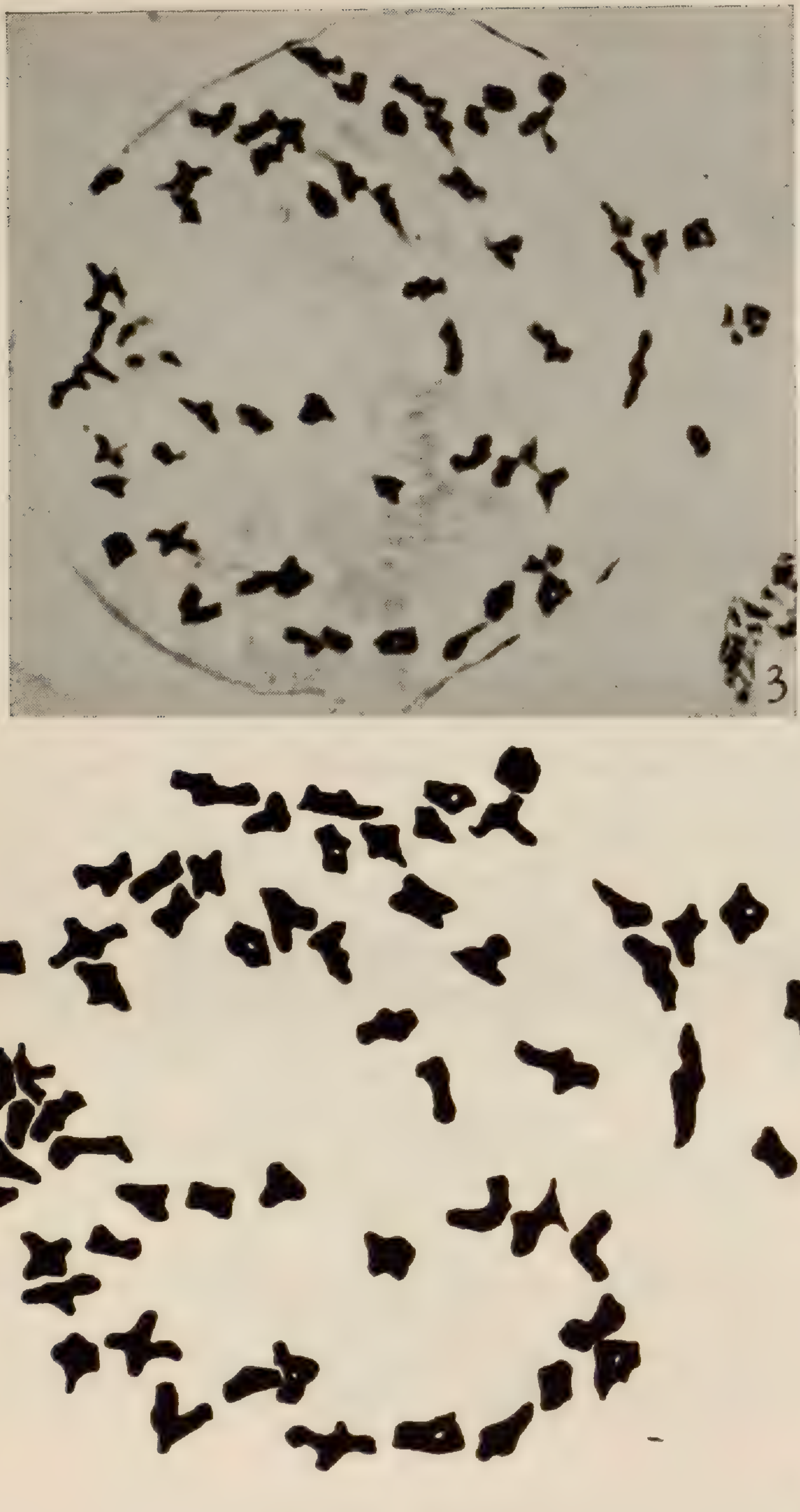
genera, namely *Antrophyum* Kaulf., and *Monogramma* Schkuhr, are also based on $x=30$ (cf. Manton, 1954). Thus these three genera form a compact alliance cytologically. This justifies Copeland's (1947) merger of Ching's (1940) family *Antrophyaceae* (comprised of *Antrophyum* Kaulf., *Polytaenium* Desv., *Anetium* Splitg., and *Ananthacorus* Underw. and Maxon) in the family Vittariaceae. Most authors (Bower, 1928; Ching, 1940; Christensen, 1938; Holttum, 1946, 1949) regard vittarioid ferns as related to gymnogrammoid ferns. Furthermore, Holttum (1946, 1949 and 1954) groups these vittarioid genera (*Vittaria, Antrophyum,* and *Monogramma*) in the family Adiantaceae. Ample support to such a relationship is forthcoming from cytological data, because many of the gymnogrammoid genera (of Christensen, 1938; Ching, 1940, and Holttum, 1954) such as *Coniogramme* Fée, *Cryptogramma* R. Br., *Hemionitis* L., *Gymnopteris* Bernh., *Pityrogramma* Link, and *Adiantum* Linn., are predominantly based on $x=30$ (cf. Manton, 1950, 1958; Manton and Sledge, 1954).

Recently Copeland (1947) suggested that the Vittariaceae might have something in common with the Hymenophyllaceae because of the similarity of the prothallia, and further that *Crepidomanes* and *Didymoglossum* produce idioblasts suggestive of those of *Vittaria*. However, the cytological data do not support this view. According to Pichi-Sermolli (1957), the characteristic spicular cells of the epidermis (idioblasts) of the Vittariaceae are present in the genus *Adiantum* also. This feature and the same basic chromosome number of $x=30$ [although according to Manton and Sledge (1954) and Britton (1953) some species of *Adiantum* are based on 29 also] suggests a certain amount of affinity between *Vittaria* and *Adiantum*. But the pro-

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FIG. 1. A SPORE MOTHER CELL OF V. HIMALAYENSIS SHOWING 60 BIVALENTS AT LATE DIAKINESIS. × 2,000.

FIG. 2. A TAPETAL CELL FROM SPORANGIUM OF V. FLEXUOSA SHOWING 120 CHROMOSOMES DURING MITOSIS. CONSTRICTIONS MOSTLY MEDIAN OR SUBMEDIAN. × 1,300.


3
4

thallia in these two genera are markedly different. No other fern with a longitudinal annulus has prothallia of the *Vittaria* type (cf. Copeland 1947).

The affinities of vittarioid ferns with the gymnogrammoid genera (named above) are, however, not in any way so convincing as to make us think of their direct origin as from gymnogrammoid stock. On the contrary, as most aptly suggested by Pichi-Sermolli (1957), these two groups of ferns, the Vittariaceae and the Adiantaceae-Gymnogrammaceae of Ching, may represent independent lines which have probably originated from a comcon stock but have specialized along different lines. This is evident so far as the habitat is concerned, the Adiantaceae being terrestrial and the Vittariaceae mainly epiphytic. Therefore, the vittarioid ferns need to be separated from Holttum's family Adiantaceae.

Although at present the vittarioid ferns have received more careful study than many other groups, except for resemblances in a few characters with other ferns, they do not present any decisive evidence of their affinity with other groups of leptosporangiate ferns. Under the present circumstances they require family status, as indicated by Copeland. As regards their systematic position they may be placed near the gymnogrammoid ferns, as suggested by Christensen, Ching, and Holttum. Certainly they should not be placed after the polypodioid ferns as done by Copeland, because they have little resemblance with the latter group.

ACKNOWLEDGMENTS

The writer is grateful to Professor P. N. Mehra for helpful criticism and encouragement, and to Professor R. C. Ching of Academia Sinica, Peking, and to Mr. C. V. Morton, of the Smithsonian Institution, Washington, for identifications. Thanks are also due to Mr. R. S. Pathania for the photomicrograph.

FIG. 3. A SPORE MOTHER CELL OF V. OPHIPOPOGONOIDES WITH $n=60$. $\times$ 2,000.
FIG. 4. EXPLANATORY DIAGRAM OF FIG. 3. V. OPHIOPOGONOIDES, $n=60$. $\times$ 2,000.

REFERENCES

BEDDOME, R. H. 1892. A Handbook to the Ferns of British India, Ceylon and Malay Peninsula, with Supplement. Calcutta.

BENEDICT, R. C. 1911. The Genera of the Fern Tribe Vittarieae: Their External Morphology, Venation and Relationships. Bull. Torrey Bot. Club, **38**: 153–190.

BRITTON, D. M. 1953. Chromosome Studies on Ferns. Amer. Journ. Bot. **40**: 575–583.

BOWER, F. O. 1928. The Ferns, Vol. III. Cambridge University Press.

CHING, R. C. 1940. On the Natural Classification of the Family "Polypodiaceae." Sunyatsenia, **5**: 201–270.

CHRISTENSEN, C. 1938. Filicinae, in Verdoorn's Manual of Pteridology. Martinus Nijhoff. The Hague.

COPELAND, E. B. 1947. Genera Filicum. Waltham, Massachusetts.

FÉE, A. L. A. 1851–1852. Troisieme Memoire: Histoire des Vittarieés et Pleurogrammeés. Paris. (Not seen.)

HOLTTUM, R. E. 1946. A Revised Classification of the Leptosporangiate Ferns. Journ. Linn. Soc. London, **53**: 123–158.

————, 1949. The Classification of Ferns. Biol. Rev., **24**: 267–296.

————, 1954. Flora Malaya, Vol. II. The Ferns. Singapore.

HOOKER, W. J. & J. G. BAKER. 1874. Synopsis Filicum, ed. 2. London.

MANTON, I. 1950. Problems of Cytology and Evolution in the Pteridophyta. Cambridge University Press.

————. 1954. Cytology of One Hundred Ferns. Appendix, Holttum, Flora of Malaya. Vol. II. The Ferns. Singapore.

————. 1958. Chromosomes and Fern Phylogeny with Special Reference to Pteridaceae. Journ. Linn. Soc. (Botany), London, **56**: 73–92.

MANTON, I., and W. A. SLEDGE. 1954. Observations on the Cytology and Taxonomy of the Pteridophyte Flora of Ceylon. Phil. Trans. Royal Soc. London, **238B**: 127–185.

PICHI-SERMOLLI, R. E. G. 1957. Adumbratio Florae Aethiopicae. 5. Parkeriaceae, Adiantaceae, Vittariaceae. Webbia, **12**: 645–704.

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Notes and News

ANNUAL MEETING:—The annual meeting of the American Fern Society will be held during the last week in August at Oregon State University, Corvallis, Oregon, in cooperation with the A.I.B.S. All members wishing to present papers at these

meetings, as a part of the Fern Society's program, should send the following information to Dr. Donald Huttleston, Longwood Gardens, Kennett Square, Pennsylvania: title of the paper, time required for its presentation, size and kind of projection equipment needed, if any. Titles must be in the hands of the Secretary not later than May 10, 1962. Those arriving at Longwood Gardens at a later date may have to be rejected. An annual field trip is being planned for the two or three day period immediately before the meetings, and announcements about the Foray will be made in the July issue of the FERN JOURNAL.

BOTANICAL SOCIETY FIELD MEETINGS:—The Northeastern Section of the Botanical Society of America will hold its Summer Field Meetings June 17–20, 1962, at the University of Delaware, with trips to the Delaware coastal plain and the environs of Longwood Gardens (southeastern Pennsylvania). All interested are invited to attend. For further information, write to Dr. Fred G. Somers, Department of Biological Sciences, University of Delaware, Newark, Delaware.

RESEARCH REQUEST:—Dr. Irving W. Knobloch, Department of Botany and Plant Pathology, Michigan State University, East Lansing, Michigan, is studying the anatomy of the xerophytic members of the genus *Cheilanthes*. He would appreciate receiving living plants of any members of the genus, and would like to have dealers who stock species of *Cheilanthes* send him lists of their offerings, as he expects to purchase some material.

American Fern Society

Report of the President for 1961

The American Fern Society experienced a surge of new members in 1961, following an article on ferns written by Helen Hull and published in the August number of *Flower Grower*.

One of the highlights of the year is always the annual fern foray and this time it was under the able leadership of Mr. Thomas McCoy. He guided us into the Cumberland Mountains of Kentucky and we extend our grateful thanks to him for his willingness to scout the area, make lodging arrangements, and

accompany us on the field trip without any compensation from the Society. It was a rare experience to see the climbing fern, *Lygodium palmatum*, which is very scarce in many parts of its range, growing as a "weed" on exposed slopes adjacent to the highway for more than a half mile. Thirty-one people attended this foray. A detailed account appeared in the JOURNAL (Vol. 51, p. 192).

Largely through the personal efforts of Conrad Morton, eleven members contributed papers at the A.I.B.S. meetings at Purdue. The Council regrets greatly the necessity of accepting Conrad's resignation as Editor of the JOURNAL because of poor health. He has filled this position successfully for many years and I am sure that the membership will concur with the resolutions passed following the luncheon at Purdue. We wish him many years of good health and extend a hearty welcome to Dr. Ira L. Wiggins, a former President, and now Editor-in-Chief.

The Council, consisting of elected officers and the Editor, has the duty of supervising the functions of the Society. Last year Treasurer Phillips presented a deficit budget for 1961; that is, the expenditures scheduled were slightly more than the anticipated income. This was approved because we have some surplus which can be used for this purpose. However, a deficit budget is an unhealthy condition.

There are a few items affecting the membership in general which need action by the new officers. The council was not in favor of an increase in dues. The constitution provides that a member must be billed twice and his dues become delinquent after two years. A member must submit a letter of resignation if he decides to drop his membership.

These provisions are expensive to the Society, because one may receive the Journal for two years before one will be dropped for non-payment of dues. Also a person may receive one or two numbers before he resigns. These numbers break a volume and part of our expenses has been in reprinting numbers which were exhausted. Several botanical societies, in order to reduce expenses, have found it necessary to advance the billing date of

the dues and have a provision that, if dues are not paid by the first of the year, those delinquent will receive none of the new year's numbers. Payment after the first of the year automatically entitles them to all numbers for that year. A system of this nature would reduce some of our expenses, but it will take an amendment to the constitution to do it, and this cannot be voted by the members until October.

The Society has the Bissell Herbarium Fund, the Reserve Fund, and the Una Weatherby Fund on deposit at a bank which pays 2% interest, and they have been in this bank for 23, 20, and 3 years respectively. Treasurer Phillips has advocated that some of the funds be invested in a mutual fund so that capital gains can be realized. Most members of the Council are either not familiar with these investment organizations or do not feel that they want the responsibility of making the decision. However, there was a definite feeling that these funds should be transferred to a Savings and Loan, or Building and Loan, firm which is federally insured and which pays from 4 to 4½% interest. The new Council should consider this change. It would more than double the accumulating interest.

Mrs. Fern Crane donated her honorarium for a lecture on Ferns of New Jersey to the Society. All contributions are appreciated.

Dr. James Johnston, Jr., is to be commended for his labors in establishing the Fern Valley in the U. S. National Arboretum at Washington, D. C. He wrote that he would like to have volunteers from the area to help in this project.

Miss Eleanor McGilliard kindly represented the Society at the installation of a new President for the University of Tennessee and I did the same for the inauguration of the new President of Tulane University.

I also attended a meeting called by the A.I.B.S. concerning a reclassification of scientists on the War Man Power Register.

It is unfortunate that I have to report no progress in the preparation of the scope or topics for a manuscript on the

cultural aspects of ferns which the American Horticultural Society is willing to publish.

I wish to thank the other members of the Council for their help and cooperation during my term of office; Dr. Charles B. Heiser, Jr., the local representative for the Society at the A.I.B.S. meetings in Purdue, for making all arrangements for our meetings there; and Dr. J. Mickel for representing the Society at a meeting to discuss the amalgamation of the botanical societies within the framework of the A.I.B.S. The Council felt that the American Fern Society should not join because the proposed assessment of $2.00 a member would require an increase in our dues. Also, most of the non-professional members of our Society would not benefit from this affiliation.

Your President was chosen as a "Participant" (a $5.00 word for student) in a summer institute of advanced biology at San Jose, Costa Rica, for six weeks. In his spare time, and during official field trips, he collected over 200 numbers of ferns. An account of this collection is being prepared, and will be submitted to this Journal later in the year.

Respectfully submitted, CLAIR A. BROWN, *President*

Report of the Secretary for 1961

After a drop in membership last year we have again resumed an upward swing. In fact, it might be called an upward jump for there has been an increase of 79 members since December, 1960, and the total membership now stands at 855. Many of the new members joined the American Fern Society as a result of an article by Helen Hull in the August issue of "Flower Grower" in which she mentioned the Fern Society.

Many will be saddened to learn that we have lost several long-standing members by death during 1961. Among them have been Life Member L. A. Bechtol (1946), Life Member Dr. Everett G. Logue (1920), Members Dr. Paul Bartsch (1911), Mrs. B. Preston Clark (1928), Mr. G. Russell Fessenden (1937), Mrs. W. Keating Johnson (1948), Dr. Jesse M. Shaver (1934), and our only surviving Charter Member, Miss Elmira B. Noyes, who had

been actively associated with the American Fern Society since 1893! We extend condolences to the members of their families and to close friends who feel keenly their losses.

The usual good time was enjoyed by the members attending the annual field trip in the Cumberland Mountains of Kentucky, reported upon in the last issue of the Journal.

The annual meetings of the Society for the presentation of papers, transaction of business by the Council, and a luncheon, were held in connection with the summer meetings of the American Institute of Biological Sciences on the campus of Purdue University, Lafayette, Indiana, on August 28th. President Clair A. Brown presided at each of the sessions. Approximately 50 persons listened to the papers presented. Titles of the papers were: "Vascularization of fern leaves," by Charles H. Young, Jr. and Robert Lommasson (read by title only); "Subgeneric interrelationships of *Anemia*," by John T. Mickel; "Pseudomeiotic sporogenesis—a new type of spore reproduction," by Virginia M. Morzenti (read by William Payne); "The taxonomic significance of leaf dimorphism in the genus *Anemia*," by John T. Mickel (read by Charles B. Beck); "Sexuality in a wild population of *Equisetum arvense* gametophytes," by Richard L. Hauke; "Cytotaxonomic studies on the *Dryopteris spinulosa* complex," by Donald M. Britton; "The cytokinetic basis of tetrahedral symmetry in the spore quartet of *Adiantum hispidulum*," by Norman P. Marengo; "Variation in the morphology of fern tracheids," by Richard A. White; "Ferns of Manitoulin Island, Lake Huron," by James H. Soper; "Some ecological and anatomical observations on the xerophytic ferns of Mexico," by Irving Knobloch (read by Richard L. Hauke); and "Model projection to reproduce microscopic effects," by Clara S. Hires. Miss Hires also had a very interesting display of her work in the exhibit hall.

The luncheon meeting was attended by twenty-five members. At a brief business meeting following luncheon, the Secretary was directed to write to Dr. Charles B. Heiser, Jr., Indiana University, and to Mr. A. T. Guard, of Purdue University,

thanking them for arranging for the meeting and luncheon; to Mrs. Helen Hull, thanking her for mention of the Fern Society in her article; and to Dr. Edgar T. Wherry, expressing the Society's appreciation for having the royalties from his book, "The Fern Guide," contributed to the American Fern Society.

The question of the proposed handbook on cultivated ferns, to be published as a special issue of the "American Horticultural Magazine," was brought up, but it was learned that little progress had been made toward its preparation. Hope was expressed that more progress would be made in 1962.

Following this meeting the members of the Council present, President Brown, Dr. Phillips, and Dr. Huttleston, joined by Dr. Cooperrider, who handles back issues of FERN JOURNAL, met briefly to discuss pricing back issues and retention of delinquent members on the rolls. Increases in sales prices of back issues of the FERN JOURNAL authorized by the Council in March, 1961, became effective on January 1, 1962, and it was the concensus that delinquent members should not be carried beyond the year for which dues have been paid. A change in the constitution to permit a shift of the date of sending out bills and for determining delinquency will be necessary, so no immediate revision of the present practice can be made.

The annual meeting for 1962 will be held in cooperation with the American Institute of Biological Sciences during its summer meetings at Oregon State University, Corvallis, Oregon, August 26-31. It is hoped that many members will attend, and that an interesting field trip preceding the meetings can be arranged.

A call for papers to be presented at the August, 1962, meetings is hereby made. Titles must be sent to the secretary on or before May 10, 1962, in order that adequate provisions may be made for the Society's participation next summer. All members wishing to give papers, must send title, time required for presentation, and type of projection equipment needed to the secretary by May 10, 1962.

Respectfully submitted, DONALD G. HUTTLESTON, *Secretary*

Report of Treasurer for 1961

This is the end of my fourth year as treasurer of your organization. During that time I think we have seen a definite membership increase. We have also seen the reserves that we had built up dwindle until we are not very far to running in the red. Steps will have to be taken to bring our income up to our present cost level. The Council ordered an increase in the price of back numbers. This took effect January 1, 1962. Back numbers now will cost 75¢ and back volumes $3.00 per volume when available. This price indicates more or less the cost of reprinting some of these. It is my opinion that within the next year the Council will have to decide on either cutting the size of the JOURNAL or increasing the dues. I think this should be given immediate consideration.

Foreign subscribers are causing more and more trouble. More than half of the foreign dealers require 3 and 4 letters with invoices in quintuplicate and receipts are wanted to conform with local customs. Handling most of the foreign subscriptions actually costs at least $1.00 each. This year we have increased the subscription rate from $2.50 to $3.00 and this may help although it is probably not enough.

Funds held in the reserve accounts in the Green Point Savings Bank are as yet untouched. These funds are receiving 4% interest. Last year I presented to the Council a comparison of what the funds would have amounted to if they had been invested in one of the conservative mutual trust funds. We are getting only interest in the Green Point Savings Bank, the capital remains the same. If the funds had been held in one of the conservative mutual trust funds, capital would have doubled.

The work of the treasurer has increased each year and it would be a lot of help if members would be more careful in making payments on time. Members should realize that they belong to the American Fern Society, and as members, they receive the JOURNAL free. If you are no longer interested, please send in a prompt resignation.

The JOURNAL is published four times a year although the dates

on this publication are slightly irregular. More and more we get requests for changes to a winter and summer address. The mailing lists are kept by the printer and we are charged for every change that is made. This makes the change of address costs rather high and because of the irregular nature of publication often by the time we have made the change of address, the person is back at his original address and then wants another change. I suggest that members make arrangements to have their mail forwarded to them when temporarily at a summer address.

While I have been treasurer of the American Fern Society for the last four years and my name is the only name that appeared on the ballot for this office, the name of my wife, Thelma K. Phillips, should have appeared on the ballot because she has done much of the book work and mailed out all of the dues notices. We have just finished the billings for 1962 and they total over 800.

May I take this occasion to thank the many friends we have made through our connection with American Fern Society. If you are ever in the Southwest, drop in and see us.

Receipts

	Amount	*Total*
Cash on hand, January 1, 1961		$ 497.81
1960 Membership—arrears	$ 60.00	
1961 Membership—renewals	1,165.31	
1962 Membership—renewals (advance)	117.50	
1961 Membership—sustaining	512.50	
1961 Memberships—new	374.54	
1962 Memberships—new (advance)	33.10	
1962 Life Memberships	100.00	
1960 Subscribers—arrears	5.20	
1961 Subscribers—renewals	214.80	
1961 Subscribers—new	44.03	
1962 Subscribers—renewals (advance)	299.43	
1963 Subscribers—renewals (advance)	17.93	
1964 Subscribers—renewals (advance)	5.00	
Sale of reprints	203.01	
Sale of back numbers	413.11	
Gifts	77.50	
Advertising	10.00	
		3,652.96
		4,150.77

Disbursements

A.F.J. Vol. 50, No. 4	613.99	
A.F.J. Vol. 51, No. 1	627.59	
A.F.J. Vol. 51, No. 2	524.19	
A.F.J. Vol. 51, No. 3	559.82	
Reprints from A.F.J.	279.60	
300 reprints of Constitution (Order of Council)	11.40	
Envelopes, addressing, stencils, mailing and postage	164.44	
Reprinting back numbers	278.68	
A.I.B.S. 1961 dues	100.00	
Refund to book agent for cancellation	2.60	
Refund to member for cancellation	2.50	
Packing and shipping back numbers to Tom S. Cooperrider	79.40	
Editor's expense—1960—$75.00, 1961—$38.44	113.44	
Secretary's expense—1961	40.97	
Treasurer's expense—1961	49.23	
Life memberships to Green Point Savings Bank ($50.00 deposited in bank January 2, 1962)	100.00	
		3,547.85
Cash in Southern Arizona Bank, January 1, 1962		$ 602.92

Statement December 31, 1961

Assets

Cash in Southern Arizona Bank	$ 602.92	
Cash in Green Point Savings Bank (Bissell Herbarium Fund)	751.11	
Cash in Green Point Savings Bank (Life Membership Fund)	963.88	
Cash in Green Point Savings Bank (Reserve Fund)	2,056.14	
Cash in Green Point Savings Bank (Una Weatherby Fund)	3,363.01	
Accounts receivable	255.98	
Inventory—American Fern Journal	2,488.00	
American Fern Society Library	396.00	
		$10,877.04

Liabilities

Advance dues collected	$472.96	
Accounts payable (Vol. 51, No. 4)	828.28	
	1,301.24	

Fund Balances

Bissell Herbarium Fund	751.11	
Life Membership Fund	963.88	
Reserve Fund	2,056.14	
Una Weatherby Fund	3,363.01	
General Fund	2,441.66	
		$10,877.04

Respectfully submitted,
WALTER S. PHILLIPS, *Treasurer*

Report of the Auditing Committee

We hereby certify that we have seen the books and accounts of Dr. Walter S. Phillips, Treasurer of the American Fern Society, Inc., and have obtained confirmation of the correctness of the Society's balances on hand as set forth in detail in the accompanying report of the Treasurer.

CHARLES T. MASON, JR.
RICHARD H. HEVLY
Auditing Committee

Report of the Judge of Elections

The results of the balloting for officers of the American Fern Society are as follows:

For President:

H. L. Blomquist	185
Donovan S. Correll	116
Clair A. Brown	2
Walter S. Phillips	1
Marcel Raymond	1

For Vice-President:

Robert C. Lommasson	298
Warren H. Wagner	2

For Secretary:

Donald G. Huttleston	299
Rolla M. Tryon	1

For Treasurer:

Richard L. Hauke	298
Elizabeth McClintock	1
Walter S. Phillips	1

I therefore declare the following officers elected: H. L. Blomquist, President; Robert C. Lommasson, Vice-President; Donald G. Huttleston, Secretary; Richard L. Hauke, Treasurer.

Respectfully submitted,

DAVID L. EMORY, *Judge of Elections*

Report of the Librarian and Curator for 1961

The year 1961 has been mostly an uneventful one for the

Library and Herbarium of the American Fern Society. Dr. D. G. Huttleston of the Longwood Gardens contributed 55 sheets of cultivated species and varieties of ferns to the Herbarium, as well as a number of assorted records and papers to the Library. A few requests for loan of literature have been received, and we have also been called upon to supply pictures of pteridophytes from the Edgar T. Wherry collection of photographic negatives.

In general, the use of both the Library and the Herbarium has been vastly greater by the rather large number of students and visitors at the University of Michigan who are involved in research on pteridophytes. Use of our materials by members of the Society in general has been very low. Probably the reason is that our members fall into different groups—those who are interested in ferns strictly as a source of enjoyment and a hobby, and those who are actually engaged in research. In the latter group are professional botanists who have literature and specimens generally available. Non-professionals who do active research often have their own libraries and herbaria too.

In recent years, the large and increasing number of persons interested in ferns strictly from the standpoint of a hobby have had available to them a series of popular writings of high quality. For example, publication of the new "Fern Guide" by Edgar T. Wherry (1961, Doubleday & Co., Garden City, New York. $3.75) makes many of the previous references on central and northeastern North America out-of-date; and already a number of our members have purchased this. The availability of such literature (and I include also the many state fern floras available now in cloth or paperback) makes the majority of items in the American Fern Society Library of historical interest only, and of special value only to researchers following the changing interpretations of species as students learned more and more about them through the years.

My point is that the American Fern Society Library seems to be of interest largely to researchers. For the majority of re-

quests for "good, readable guides to the ferns," it is possible to cite good pamphlets or books available free or at reasonable prices. Our major need for good fern guides is the Western United States. Mrs. Carlotta C. Hall, before her untimely death in 1949, was preparing such a guide, but the work was still at such an early stage that it has been impossible since to retrieve it for posthumous publication. A good, scientifically accurate book on the ferns of the West Coast of the United States is still very much in demand.

What I have written with regard to the American Fern Society Library applies also, to some extent, to the Herbarium. The collections of the Society include historically important materials of such workers as Campbell E. Waters, Amy A. Lillibridge, F. W. Hunnewell, E. P. St. John, and others. Many of the specimens are duplicates of specimens represented in institutional herbaria. With rare exceptions, the requests for materials that I receive are not for scientific collections but for demonstration specimens—at garden shows, illustrated talks, and wild flower societies. The specimens we have are simply not suitable for such purposes. The majority of them are old (up to a half-century or more) and faded, and not at all attractive or effectively illustrative. Our material as it stands is of interest and value largely to researchers. For the purpose of demonstrations at garden shows, popular talks on pteridophytes, and so on, I believe the Society should build up a special set of specimens on heavy herbarium paper, properly fastened down with rigid plastic "straps," and covered with cellophane or a similar protection. I bring this up merely as a suggestion, with the hope that members of the Society who may have an interest in this matter will communicate their views, *pro* or *con*, to me.

Respectfully submitted,

WARREN H. WAGNER, JR., *Librarian and Curator*

NEW MEMBERS

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Mr. David L. Woolsey, Route 1, Box 140, Ione, Calif.

A CORRECTION.—For the benefit of those members of the American Fern Society who may wish to send ferns for the Fern Valley at the National Arboretum I should like to make a correction to my article in volume 51, number 4, of the Journal. Mrs. Morrill Donnald's address is 3703 Jones Bridge Road, Chevy Chase, Maryland, not "Jones Road" as given in the article. We are please that several offers of ferns came in within ten days of publication of the article.—EDITH BITTINGER.

Suggestions to Contributors to the American Fern Journal

1. Authors of papers submitted to the *American Fern Journal* should consult the *Style Manual for Biological Journals* (1960) and be guided by its examples.

2. The "name-and-year" system for bibliographic references will, except in exceptional cases, be used. (See Literature Cited below for an example).

3. Authors are encouraged to use the journal abbreviations set forth by Schwarten and Rickett (1958, 1961).

4. Abbreviations of names of herbaria will be those listed by Lanjouw and Stafleu (1959).

5. Reports of chromosome numbers will not be accepted unless documented.

6. The use of footnotes and tabular matter should be kept to a minimum.

7. All manuscripts submitted for publication should be typed, double-spaced, and have ample margins.

8. Reprints should be ordered when galley proof is returned to the Editor. An order blank will be included with the galley proof.

Literature Cited

American Institute of Biological Sciences, Committee on Form and Style of the Conference of Biological Editors. 1960. Style Manual for Biological Journals. American Institute of Biological Sciences. Washington, D. C. 100 p.

Lanjouw, J., and F. A. Stafleu. 1959. The Herbaria of the World. Index Herbariorum 15: 1-249.

Schwarten, L., and H. W. Ricket. 1958. Abbreviations of Titles of Serials Cited by Botanists. Bull. Torrey Club 85: 277-300; 1961. Supplement I. Ibid. 88: 1-10.

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VOL. 52 APRIL-JUNE, 1962 No. 2

American Fern Journal

A QUARTERLY DEVOTED TO FERNS

Published by the

AMERICAN FERN SOCIETY

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The American Fern Society

Council for 1962

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American Fern Journal

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ROLLA M. TRYON
Gray Herbarium, Harvard University, Cambridge 38, Mass.
JOHN H. THOMAS—Dudley Herbarium, Stanford University, Stanford, Calif.

An illustrated quarterly devoted to the general study of ferns, published quarterly by the American Fern Society, 3110 Elm Ave., Baltimore 11, Md. Second-class postage paid at Baltimore, Md.

Matter for publication should be addressed to Ira L. Wiggins, Natural History Museum, Stanford University, Stanford, California.

Subscription $3.00, exclusive of agency handling fees; sent free to members of the American Fern Society (annual dues, $2.50; sustaining membership, $5.00; life membership, $50.00). Extracted reprints, if ordered in advance, will be furnished authors at cost, plus postage.

Back volumes $3.00 each; single back numbers 75 cents each; Cumulative Index to vols. 1-25, 25 cents. Ten per cent discount on orders of six volumes or more.

Changes of address, applications for membership, subscriptions, orders for back numbers, and other business communications should be addressed to the Treasurer, Dr. Richard L. Hauke, Department of Botany, University of Rhode Island, Kingston, Rhode Island. Members and subscribers should allow two months for changes in address to take effect.

LIBRARIAN AND CURATOR OF THE HERBARIUM

Dr. W. H. Wagner, University of Michigan, Ann Arbor, Mich.

A regular loan department is maintained in connection with the library and herbarium. Members may borrow books and specimens at any time, the borrower paying all postal or express charges. The pages of the Journal also are open to members who wish to arrange exchanges; a membership list is published at intervals, to assist those interested in obtaining specimens from different localities.

American Fern Journal

VOL. 52 APRIL-JUNE, 1962 NO. 2

A Resume of the Taxonomic Reorganization of Equisetum, Subgenus Hippochaete, III

RICHARD L. HAUKE

C. Section *Hippochaete*.

Hippochaete sect. *Euhippochaete* Farw. Mem. New York Bot. Gard. **6**: 463. 1916.

Hippochaete sect. *Stichopora* Rothm. Repert. Sp. Nov. Fedde **54**: 81. 1944.

Medium to small plants with evergreen stems, unbranched, the stomata in single lines; cones apiculate; ridges furrowed (except sometimes in *E. hyemale* var. *affine*); stem endodermis double or single. Type species: *Equisetum hyemale* L.

Ca. Subsection **Perennantia** (Döll) Hauke, *comb. nov.*

"*Equisetum II. Homophyadica* B. *E. hiemalia*" A. Braun, Flora **22**: 308. 1839 (*pro parte*) (Invalid).

Equisetum II. Sclerocaulon b. *Perennantia* Döll, Flora des Grossherz. Baden. **1**: 67. 1857.

Equisetum II. Equiseta cryptopora C. *Equiseta monosticha* c. *Hiemalia* Milde, Verh. Zool.-Bot. Ges. Wien **14**: 526. 1864 (*nom. nud.*).

Equisetum sect. *Hyemalia* A. Braun ex Boiss. Fl. Orient. **5**: 742. 1884.

"*Equisetum* sect. *Equiseta Hiberna*" Schaffn. Amer. Fern Journ. **11**: 68. 1921 (*pro parte*) (Invalid).

Equisetum subg. B. *Hippochaete* sect. I. *Hyemalia* (A. Braun) Viet. Contr. Lab. Bot. Univ. Montreal **9**: 14. 1927 (*pro parte*).

Volume 52, No. 1, of the JOURNAL, pp. 1-56, was issued April 12, 1962.

Hippochaete sect. *Stichopora* subsect. *Hiemalia* (A. Braun) Rothm. Repert. Sp. Nov. Fedde **54**: 81. 1944 (*pro parte*).

The type and only species of this subsection is *Equisetum hyemale* L.

5. EQUISETUM HYEMALE L.

The ashy grey sheaths girdled with black, the abscission layer formed at the base of the teeth, and the medium-sized evergreen, unbranched stems of this species, the true scouring rush, make it quite distinctive. It has a double common endodermis in the stem and individual endodermises in the rhizome. The carinal collenchyma is well-developed whereas the vallecular is nearly absent. The cones are prominently apiculate.

Ranging around the world in the northern hemisphere, this species reveals some differences in the eastern and western hemispheres, and is here divided into two varieties.

5a. EQUISETUM HYEMALE L. VAR. HYEMALE.

E. hyemale L. Sp. Pl. **2**: 1062. 1753.

The European and western Asiatic populations belong to this variety, which is remarkably uniform throughout its range. The ridges have two rows of silica tubercles with a median furrow separating them, making them appear bituberculate in stem cross-sections. These rows of tubercles continue into the sheath segments, which are thus 4-ridged, or quadricarinate. The sheaths are about half again as long as wide. The sheath teeth are pushed off during stem elongation, and may be found at the top of stems as a series of superposed cones, resembling a small pagoda.

I have seen specimens of this variety from Iceland, Europe, Algeria, Asiatic Russia to Irkutsk, and Sinkiang, China. It usually grows in woods and along rivers, ditches, and railroad tracks.

Many of the named varieties of *E. hyemale* in Europe are actually hybrids formed by it with either *E. ramosissimum* subsp. *ramosissimum* (see *E.* × *moorei*) or *E. variegatum* (see *E.* × *trachyodon*).

The specimen of *E. hyemale* in the Linnaean herbarium in London was not present in 1753, according to Savage (1945), and hence it can hardly be the type. However, in the absence of a holotype, this specimen may serve as a neotype.

5b. EQUISETUM HYEMALE L. var. AFFINE (Engelm.) A. A. Eat. Fern Bull. **11**: 111. 1903.

E. prealtum Raf. Fl. Ludovic. 13. 1817.

E. robustum A. Br. Amer. Journ. Sci. **46**: 88. 1844.

E. robustum γ *affine* Engelm., Amer. Jour. Sci. **46**: 88. 1844.

E. hiemale var. *californicum* Milde, Verh. Zool-Bot. Ges. Wien **12**: 1264. 1862.

E. komarovi Iljin, Flora URSS **1**: 110. 1934.

E. hyemale var. *pseudohyemale* (Farw.) Morton, in Gleason, New Ill. Fl. N. U.S. and Adj. Can. **1**: 16. 1952.

The North American variety of *E. hyemale* is so variable that it is hard to characterize. In general, it is larger than its European counterpart, and it has cross-bars of silica on the ridges rather than two rows of tubercles. Thus the ridges appear convex or flattened rather than bituberculate in cross-section, and the sheath segments are tricarinate rather than quadricarinate. The sheaths are about as long as wide. The sheath teeth, although articulated as are those of the European variety, are at times slow to abscise or fail to do so.

This variety ranges throughout North America from Guatemala to the mouth of the St. Lawrence river, and to central Alaska, and it extends across the Aleutian chain to the Pacific coast of Asia where it is found from Kamchatka and eastern Manchuria to Korea and Japan. It grows in many habitats—river banks, roadsides, railroad embankments, woods, fields, and swampy places.

Most floras divide *E. hyemale* in America into three varieties or species: *E. hyemale* var. *affine* (or var. *pseudohyemale*) in northern and eastern regions is of medium size and has promptly deciduous teeth; *E. hyemale* var. *robustum* or var. *elatum* (*E.*

prealtum, E. robustum) of southern and central to western regions is a large plant with tardily deciduous or persistent teeth. Both of the above have convex or flattened ridges. Plants from the Far West and Northwest, with bituberculate ridges, are called *E. hyemale* var. *californicum.*

An analysis of the variation of *E. hyemale* in North America revealed that there are three characters which vary clinally, and that each is independent of the others. The plants increase in average size from north to south. Specimens collected in the southeast have strongly convex ridges, and there is a gradual change to flattened or slightly concave, and finally to strongly bituberculate ridges from specimens collected progressively farther to the northwest. Plants in the south and central states have a high percentage of teeth retention, while those from both the West and the Northeast show a lower percentage of teeth retention. The interplay of these three clinal characters produces the overall pattern of variation, which has been responsible for the several specific and varietal names assigned to *E. hyemale* in North America. However, variation in any one of these characters is so gradual that lines cannot be drawn to separate definitely one condition from the other. Though a specimen from New York, one from Louisiana, and one from California may look quite different, the differences are the end result of this gradual variation. According to Stebbins (1950, p. 47), such characters should not be used to segregate infraspecific taxa. Therefore I have placed all American representatives of *E. hyemale* in a single variety, var. *affine.*

In Alaska and eastern Asia, var. *affine* intergrades with var. *hyemale* in average size and sheath length-width ratio, and has the ridges definitely bituberculate. All specimens from this region retain all the sheath teeth, however, revealing themselves to be a continuation of clines within *E. hyemale* var. *affine.* In New England and Quebec *E. hyemale* var. *affine* approaches var. *hyemale* in average size and nearly complete abscission of teeth, but there the ridges are only slightly biangulate, never

bituberculate, and the sheath length-width ratio is low, evidence that the populations in this area are also a continuation of clines in *E. hyemale* var. *affine.*

Equisetum hyemale var. *affine* hybridizes with *E. variegatum* to produce *E.* × *trachyodon,* with *E. laevigatum* to produce *E.* × *ferrissii,* and with *E. myriochaetum* to produce an unnamed hybrid.

Cb. Subsection **Homocormia** (Pfitz.) Hauke, comb. nov.

"Equiseta cryptopora a. *E. monosticha"* Milde, Jahresber. Schles. Gesell. **39**: 138. 1861 (*pro parte*). [Same as Abh. Schles. Gesell. **2**: 138. 1861.]

"Equisetum II *Equiseta cryptopora* C. *Equiseta monosticha* d. *Equiseta trachyodonta"* Milde, Verh. Zool.-Bot. Ges. Wien **14**: 525. 1864 (Invalid.).

"Equiseta cryptopora" 1. *Bivaginata* b. *Homocormia* Pfitz. Jahrb. Wiss. Bot. **6**: 358. 1867.

"Equiseta cryptopora" 2. *Univaginata* [bis] Pfitz. *loc. cit.* (Illegit.).

Equisetum subg. B. *Hippochaete* sect. II. *Scirpoidea* Vict. Contr. Lab. Bot. Univ. Montreal **9**: 14. 1927.

"Equisetum sect. *Equiseta Pusilla"* Schaffn. Amer. Fern Journ. **20**: 12. 1930 (Invalid.).

Hippochaete sect. *Stichopora* subsect. *Homocormia* (Pfitz.) Rothm. Repert. Sp. Nov. Fedde **54**: 81. 1944.

Hippochaete sect. *Univaginata* Rothm. *loc. cit.*

These plants have mostly smaller stems with persistent sheath teeth and with ridges deeply furrowed. The rhizomes have a double common or an outer common endodermis. The subsectional epithet refers to the existence of the same endodermal pattern in both aerial stem and rhizome of *E. variegatum,* a character found also in *E. scirpoides.* Type species: *Equisetum variegatum* Schleich.

6. EQUISETUM VARIEGATUM Schleich.

Here are included medium to small, unbranched plants with

usually four or more ridges and as many sheath segments. The vallecular and carinal collenchyma are of equal extent in the stem. Both stems and rhizomes show the double common endodermal pattern, and the rhizome has a shiny black epidermis.

6a. EQUISETUM VARIEGATUM Schleich. var. VARIEGATUM.

E. variegatum Schleich. in Usteri, Neue Ann. Bot. **21**: 120–135. 1797.

The wide white margins and brown central portions of the sheath teeth give a variegated look to the rather small, clustered stems of this variety. The sheaths are slightly spreading upward. A truly circumboreal variety, *E. variegatum* var. *variegatum* grows in North America from Alaska to Newfoundland and from Ellesmere Island to Utah, on Greenland, and Iceland, and in Eurasia from Ireland to Kamchatka and from Spitzbergen to Switzerland. In both North America and Eurasia there is a progressive increase in mean height from north to south. The smallest forms were grouped with *E. scirpoides* as *E. reptans* by Wahlenberg.

Hybridization of *E. variegatum* var. *variegatum* with *E. hyemale* occurs readily where these are sympatric, forming what has been known in America as *E. variegatum* var. *jesupii* and in Europe as *E. trachyodon* (to be discussed in the fourth paper of this series). *Equisetum variegatum* also hybridizes with *E. laevigatum* to form *E.* × *nelsonii* (*E. variegatum* var. *nelsonii*). One collection appearing to be a hybrid between *E. variegatum* and *E. ramosissimum* has been found, but since the ranges of these species overlap only slightly such hybrids are uncommon. Although sympatric with *E. scirpoides* over most of its range, *E. variegatum* apparently does not hybridize with that species.

Depauperate forms of *E. hyemale*, *E. laevigatum*, *E. ramosissimum*, *E.* × *ferrissii*, and *E.* × *moorei*, as well as hybrids with *E. variegatum* as one parent, are sometimes misidentified as *E. variegatum*.

6b. EQUISETUM VARIEGATUM Schleich. var. ALASKANUM A. A. Eat. in Harriman Alaska Exped., **5**: 390. 1904.

A well-defined variety, differing from *E. variegatum* var. *variegatum* in its more robust habit and black, incurved teeth, *E. variegatum* var. *alaskanum* is of limited geographic distribution. It is found along the Pacific coast of North America from Vancouver Island to Unalaska, in the Aleutians, and intergrades completely with var. *variegatum* in Washington, British Columbia, and the mainland of Alaska.

7. EQUISETUM SCIRPOIDES Michx. Fl. Bor. Am. **2**: 281. 1803.

Equisetum scirpoides is the smallest of section *Hippochaete*. Because its three ridges are so deeply furrowed, it appears to have six ridges and only three sheath segments and teeth. This character, plus its outer common endodermis in both stem and rhizome, makes *E. scirpoides* unique in *Hippochaete*.

Although present in Europe, it was first described from North America, where it ranges from Alaska to Labrador, south to Washington, northern Illinois, and Connecticut. In Eurasia it is found from Greenland and Spitzbergen to Siberia and Kamchatka and south to Scandinavia and Lithuania. Thus *E. scirpoides* is circumboreal, like *E. varicgatum*, but extends neither as far north nor as far south as that species.

Since it is so distinctive, *E. scirpoides* has usually been correctly identified and its nomenclature is simple. Small specimens of *E. variegatum* with only 3 or 4 ridges have been incorrectly identified as *E. scirpoides*, and larger specimens of *E. scirpoides* have been labeled *E. variegatum*. The ratio of two internodal ridges per sheath segment should always permit the correct identification of *E. scirpoides*.

LITERATURE CITED

SAVAGE, S. 1945. A Catalogue of the Linnaean Herbarium. London.
STEBBINS, G. L. 1950. Variation and Evolution in Plants. Columbia University Press, New York.

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Cultivating the Hartford Fern

WALDO TODD PRATT

I first became interested in the Hartford Fern, or Climbing Fern (*Lygodium palmatum*), some eight years ago when a friend showed me a station for it. When I chanced to mention this station to Miss Farida Wiley, of the American Museum of Natural History, she immediately wrote me: "Don't show your Hartford Fern station to anyone, not even botanists, particularly not botanists!" I hadn't realized before that this fern is something of a rarity. I was stimulated to try and raise it from spores, with little knowledge and no experience.

Guided by the book by Edith Roberts and an article by Anne Seaman, and by personal advice from Boughton Cobb, the Rev. Jesse F. Smith, and Professor Forman McLean I tried various methods for six years without success. Half of my cultures were killed by fungi either in germination or in the prothallial stage, and the other half were killed by any fungicide that I tried, even the one recommended by Miss Seaman and used by her when she raised hundreds of ferns from spores. However, finally in January, 1960, a culture survived and by May, 1960, I had 24 healthy Hartford ferns. By October, 1960, they had graduated to 4½ inch pots, and were sending out runners with many new fronds. In November, 1960, unfortunately they began to die and by May, 1961, they were to all appearance definitely dead.

I consulted the chemist for our local water supply to find out if the fluorine that has been added to the water stays in. He told me that it did, but that he doubted that it affected plant life. But he added that for a year and a half they had been adding lime to the water and had gradually brought the pH up from 4.5 to 6.75 or 7. Professor Wherry had warned me that the slightest trace of lime would kill Hartford Fern, and so I at once brought the pH down from 7 to 4.5 by the addition of aluminum sulphate. Now, eight weeks later, 16 of my "dead" ferns have come to life and are shooting up fronds from six inches to a foot high.

I am growing my Hartford Ferns in pots filled to about one inch deep with long-fibered sphagnum without shards, the balance of the pot being filled half and half by weight with fine sphagnum and sifted soil from the station from which the spores came. The pots are bedded in deep Vermiculite. They get about 16 hours a day of cold white fluorescent light of about 500 foot-candles. They are watered profusely from the bottom and fed Hyponex about three times a month.

84 MAPLEWOOD AVENUE, WEST HARTFORD 7, CONNECTICUT.

Tetraploid Polypodium vulgare var. columbianum from Arizona[1]

IRVING W. KNOBLOCH

It is evident that the critical study of ferns, as judged by the recent literature on this group, can provide us with much-needed information about problems of speciation. One group especially needing this attention is that of the "*Polypodium vulgare*" group. A member of this complex is the subject of this paper.

Polypodium vulgare L. var. *columbianum* Gilbert (Fig. 1) is a plant favoring rocky habitats in the western parts of the United States and Canada (Gilbert, 1901).

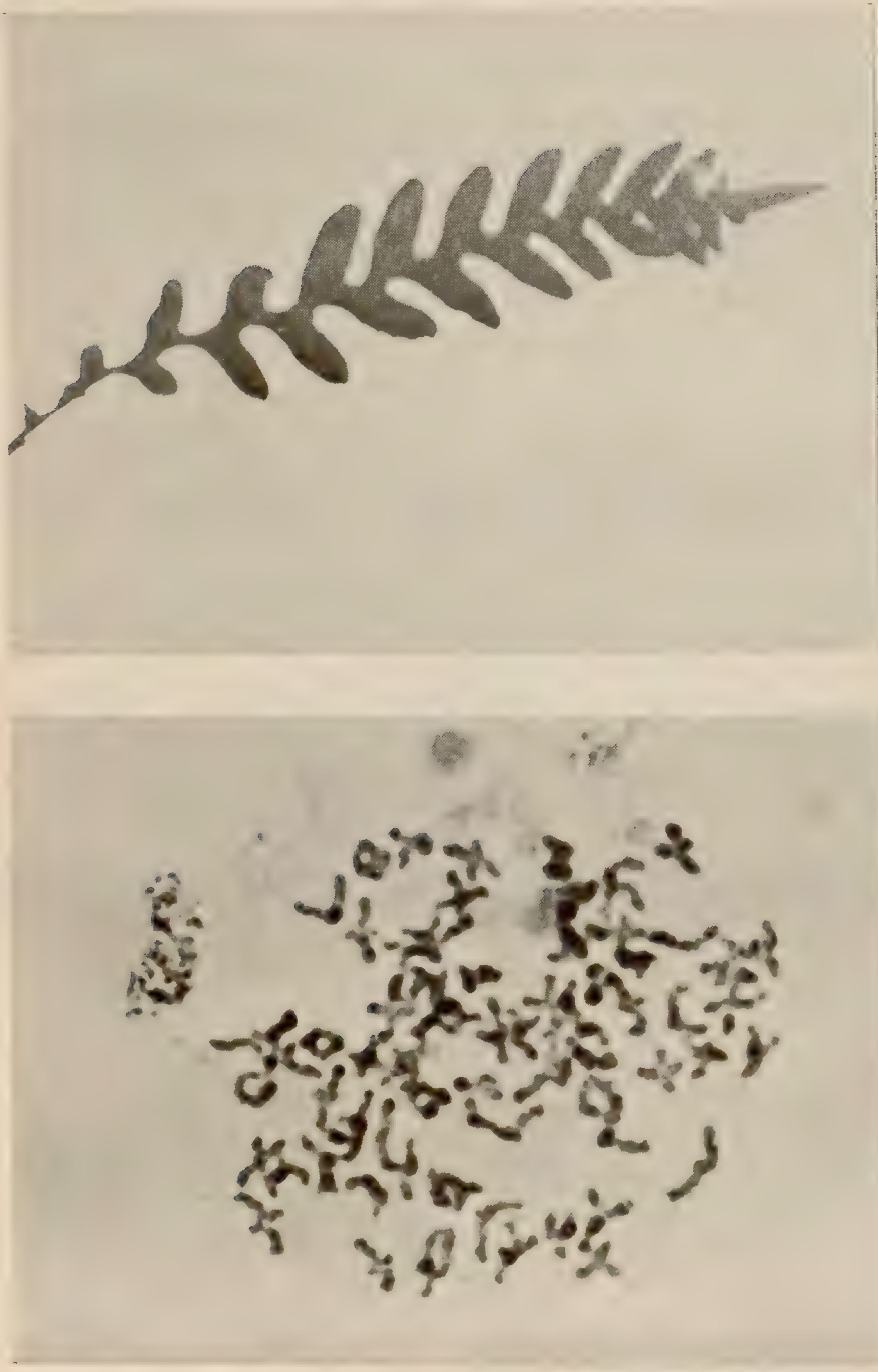
Polypodium hesperium Maxon is considered by Fernald (1922) to be a synonym of the variety under consideration although Manton (1951) prefers to use the epithet *hesperium*.

MATERIALS AND METHODS

Rhizomes were collected in 1960 from a large rock in the Santa Catalina Mountains, just north of Tucson, Arizona (*Knobloch 1630*, MSC). They were wrapped in moist cheesecloth, then in wax paper, transported approximately 1800 miles to Michigan.

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[1]Contribution No. 61-13 from the Department of Botany and Plant Pathology, Michigan State University.



potted into rich soil and placed in a greenhouse with a temperature of approximately 12 degrees centigrade. Pinnae with colorless sporangia were killed and fixed in 6 parts methanol, 3 parts chloroform and 2 parts propionic acid. After 24 hours, they were stored in 70% ethyl alcohol. The sporangia were pounded in aceto-carmine with a glass rod and iron was added with a rusty sewing needle. Gentle heating over an alcohol lamp was employed during the addition of the iron. A drop of Hoyer's Medium (Beeks, 1955) was stirred into the mixture and a cover slip added. The slide was heated, pressed between paper toweling, weighted and then allowed to dry. The advantage of using the Hoyer's Medium is that one obtains a permanent slide without the subsequent necessity of removing the cover slip. The slides do not dry as fast, however, as with the usual mounting media.
We acknowledge the assistance of Mr. Robert Maronpot. The photograph for the study was taken by Mr. Philip Coleman.

RESULTS

An examination of diakinesis (Fig. 2) reveals a complement of 74 bivalents. These are of three types: the X-shaped bivalent with at least one chiasma and possibly two, the ring bivalent with two chiasmata and the closely-appressed rod bivalents with an undetermined number of chiasmata. There are, apparently, no univalents present. The spore number per sporangium is variable, as is frequently the case with ferns. Counts of 56, 57, 60 and more have been encountered, but in no case did the number exceed 64. With perfect functioning of the meiotic mechanism, we would expect to find 64 bilateral, verrucose spores in each sporangium.

DISCUSSION

Chiarugi (1960) has performed an important service for the pteridologist by bringing together nearly all of the reports of

FIG. 1. SILHOUETTE OF FROND, × 1.
FIG. 2. DIAKINESIS IN SPORE MOTHER CELLS, × 1800.

chromosome counts made to date. The base number for the genus *Polypodium* is evidently 37. Dr. Manton (1951) investigated the chromosome number of plants of *P. hesperium*, a synonym of *P. vulgare* var. *columbianum*, from the Columbia River region of Oregon and found the $2n$ number to be 74, hence a diploid. Our plants, taken almost 1000 miles southeast of her collection, are tetraploid.

Our collection's identity was checked by Mr. Conrad Morton of the Smithsonian Institution. If *P. hesperium* is reduced to synonymy under *P. vulgare* var. *columbianum*, we have here an instance of two levels of ploidy in the same variety. Although this condition would be a possibility, it is also likely that Dr. Manton's material and my material do not, in fact, belong to exactly the same taxon. Because of the tetraploid nature of our taxon and the regular pairing of the chromosomes, the deduction can be made that our taxon is an allotetraploid. Other tetraploids in the genus (Chiarugi, 1960) are *P. californicum*, *P. virginianum* (?), and *P. vulgare*. Mass collections of the variety *columbianum* should be made from other areas in the southwest to determine the pattern of ploidy and to investigate the origin of the entity. In Europe, the "*vulgare*" complex has three levels of ploidy. In the United States, breaking the complex into species such as *P. glycyrrhiza*, *P. californicum*, and *P. scouleri* has complicated the picture and indicated the need for critical studies of this nature.

REFERENCES

BEEKS, R. M. 1955. Improvements in the Squash Technique for Plant Chromosomes. Aliso **3:** 131-133.

CHIARUGI, ALBERTO. 1960. Tavole Cromosomiche Delle Pteridophyta. Caryologia **13:** 27-150.

FERNALD, M. L. 1922. *Polypodium virginianum* and *P. vulgare*. Rhodora **24:** 138-142.

GILBERT, BENJAMIN D. 1901. Working List of North American Pteriodphytes (North of Mexico) Together with Descriptions of a Number of Varieties not Heretofore Published. Utica, N. Y.

MANTON, I. 1951. Cytology of *Polypodium* in America. Nature **167:** 37.

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A First Report on Pseudomeiotic Sporogenesis, a Type of Spore Reproduction by Which "Sterile" Ferns Produce Gametophytes

VIRGINIA M. MORZENTI[1]

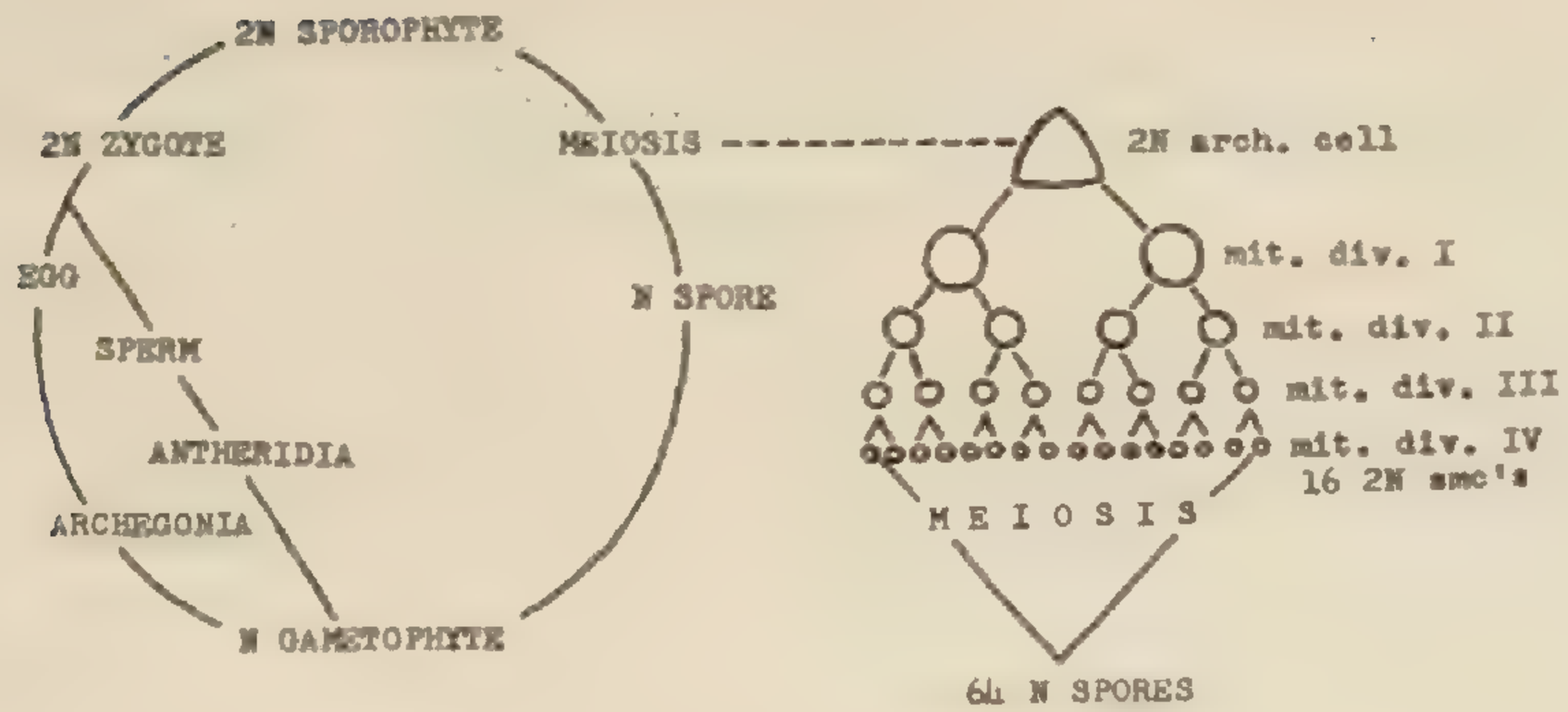
Among the ferns there are two classical types of life cycles involving spore reproduction—the "normal" sexual life cycle, first described by Hofmeister in 1864, and the obligate-apogamous life cycle, discovered by Farlow in 1874. These are now so well known that it is necessary to say only that in the sexual life cycle, a diploid sporophyte gives rise to haploid spores, which form haploid gametophytes. The latter produce haploid eggs and sperms, and upon fertilization, these yield new diploid sporophytes (Fig. 1A). In the obligate apogamous life cycle, details of which were established by Döpp in 1932 and later confirmed by Manton (1950), the sporophyte produces diploid spores which form diploid gametophytes. The gametophytes tend to form antheridia with viable sperm but few or no archegonia. Production of a new sporophyte is accomplished simply by proliferation of cells from the diploid gametophyte (Fig. 1B).

Other methods of reproduction in ferns are known, such as the various types of vegetative offsets from sporophytes or gametophytes, but no spores are involved. Only two basic patterns of reproduction involving spores, briefly described above, are known to occur.

In the present report, I wish to describe briefly another pattern of at least partial reproduction involving spores which has been, apparently, overlooked in the past, and which may be more common than is realized. Surprisingly, the plants involved are generally considered to be wholly sterile, *i.e.*, incapable of reproduction by spores, because the spores, when seen under

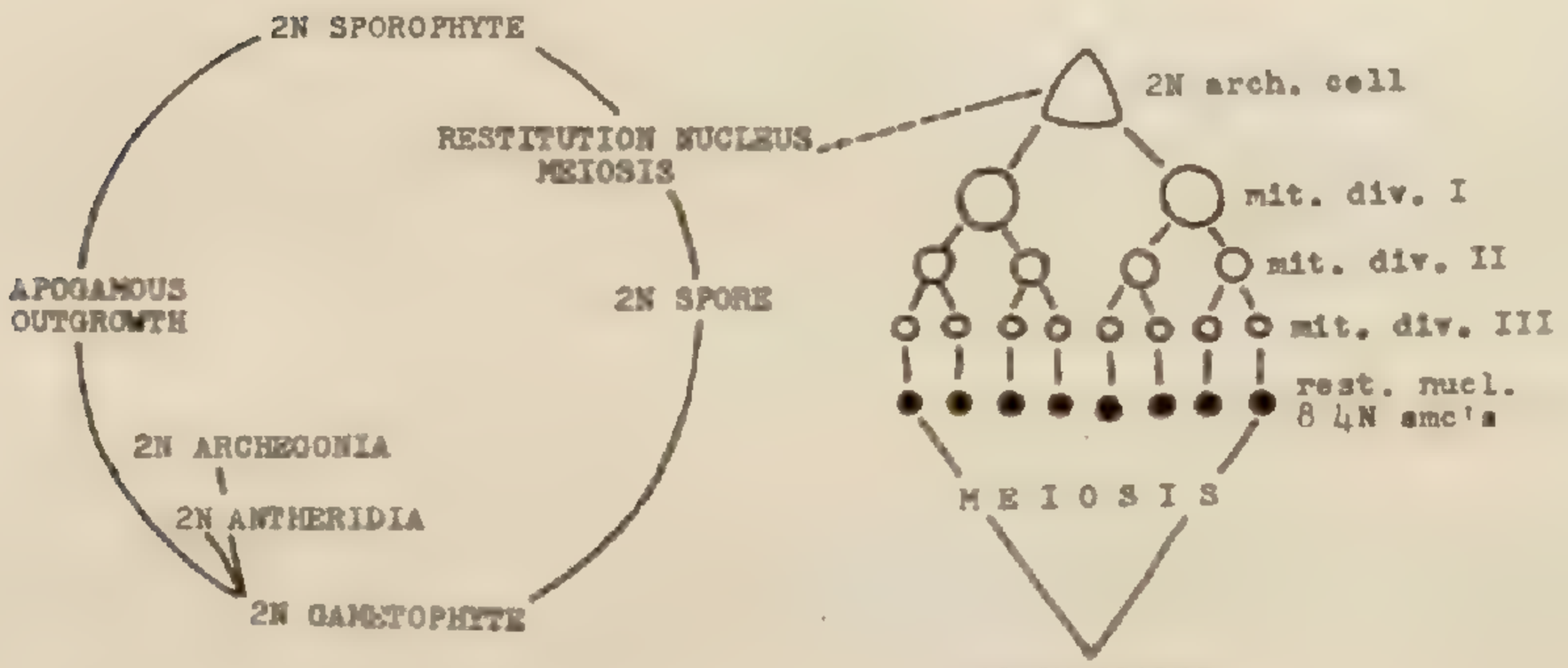
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[1]Based on a paper read at the American Fern Society meeting at Purdue University, August 28, 1961. The materials for this study were made available through National Science Foundation Grant G-10846. The help and guidance of Doctors Robert J. Lowry and Warren H. Wagner, Jr., is gratefully acknowledged.



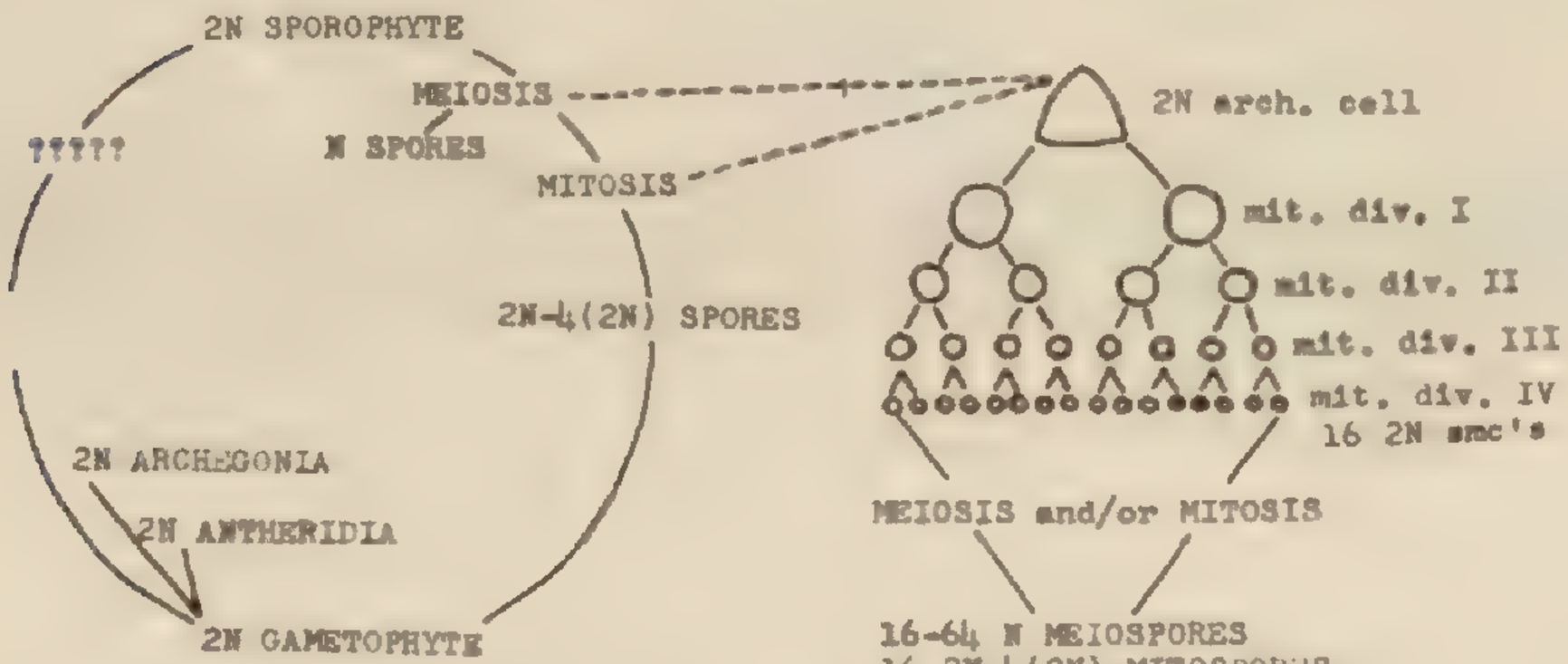
A

SEXUAL LIFE CYCLE



B

OBLIGATE APOGAMOUS LIFE CYCLE



C

PSEUDOMEIOTIC APOGAMOUS LIFE CYCLE

FIGURE 1. TYPES OF LIFE CYCLES IN FERNS. THE RIGHT HAND FIGURES SHOW ALL THE NUCLEAR DIVISIONS, BEGINNING WITH A SINGLE DIPLOID ARCHESPORIAL CELL, WHICH OCCUR WITHIN A SINGLE SPORE MOTHER CELL. A, COMPLETE SEXUAL ALTERNATION OF GENERATIONS. B, COMPLETE APOGAMOUS ALTERNATION OF GENERATIONS. C, INCOMPLETE ALTERATION OF GENERATIONS INVOLVING SPORES FROM "STERILE HYBRIDS."

the microscope, are highly irregular in size, shape, and content (Fig. 2).

As seen *en masse*, this is the case. But during the summers of 1960 and 1961, a phenomenon was noted which led to the study described in this paper. While making cytological studies of

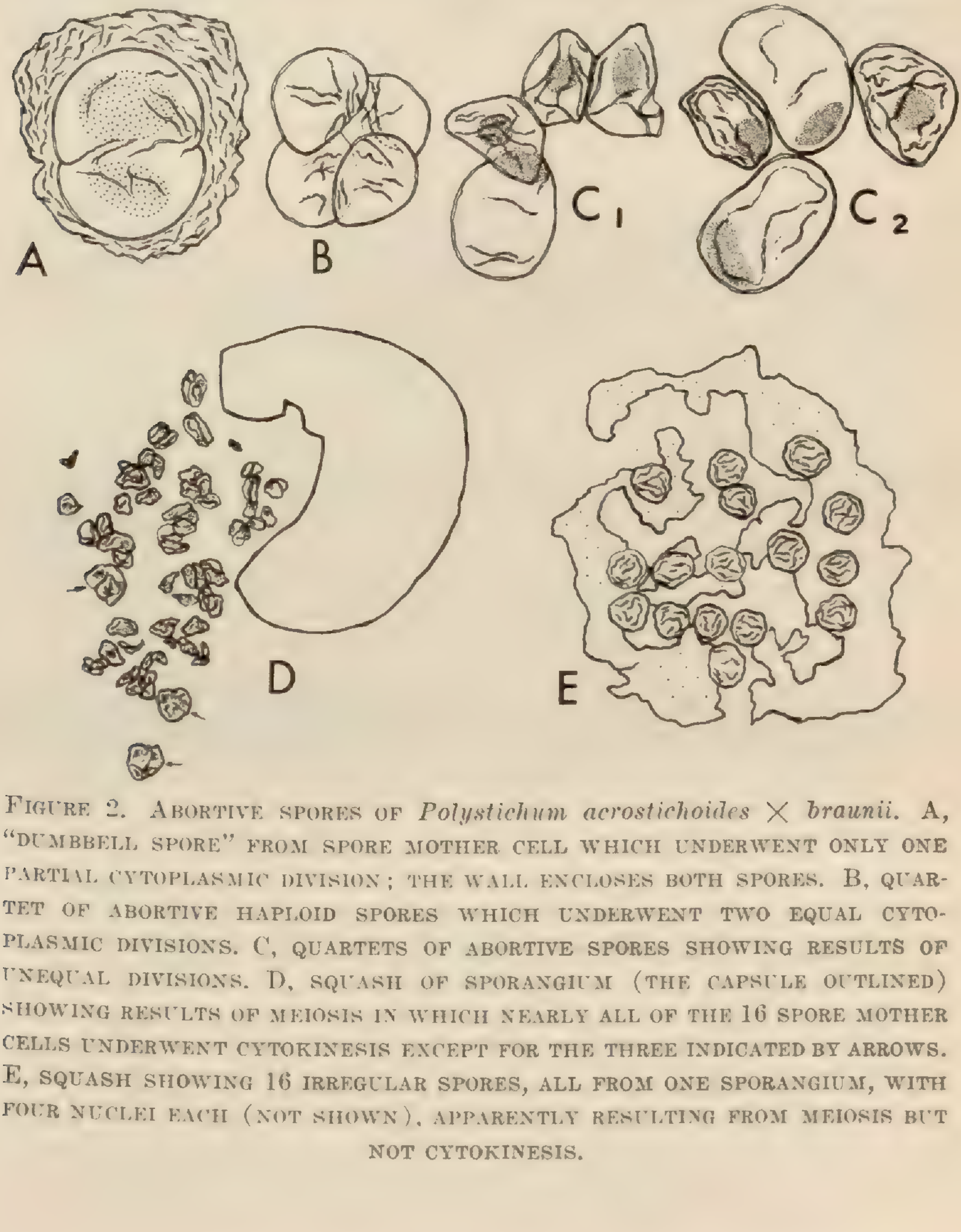


FIGURE 2. ABORTIVE SPORES OF *Polystichum acrostichoides* × *braunii*. A, "DUMBBELL SPORE" FROM SPORE MOTHER CELL WHICH UNDERWENT ONLY ONE PARTIAL CYTOPLASMIC DIVISION; THE WALL ENCLOSES BOTH SPORES. B, QUARTET OF ABORTIVE HAPLOID SPORES WHICH UNDERWENT TWO EQUAL CYTOPLASMIC DIVISIONS. C, QUARTETS OF ABORTIVE SPORES SHOWING RESULTS OF UNEQUAL DIVISIONS. D, SQUASH OF SPORANGIUM (THE CAPSULE OUTLINED) SHOWING RESULTS OF MEIOSIS IN WHICH NEARLY ALL OF THE 16 SPORE MOTHER CELLS UNDERWENT CYTOKINESIS EXCEPT FOR THE THREE INDICATED BY ARROWS. E, SQUASH SHOWING 16 IRREGULAR SPORES, ALL FROM ONE SPORANGIUM, WITH FOUR NUCLEI EACH (NOT SHOWN), APPARENTLY RESULTING FROM MEIOSIS BUT NOT CYTOKINESIS.

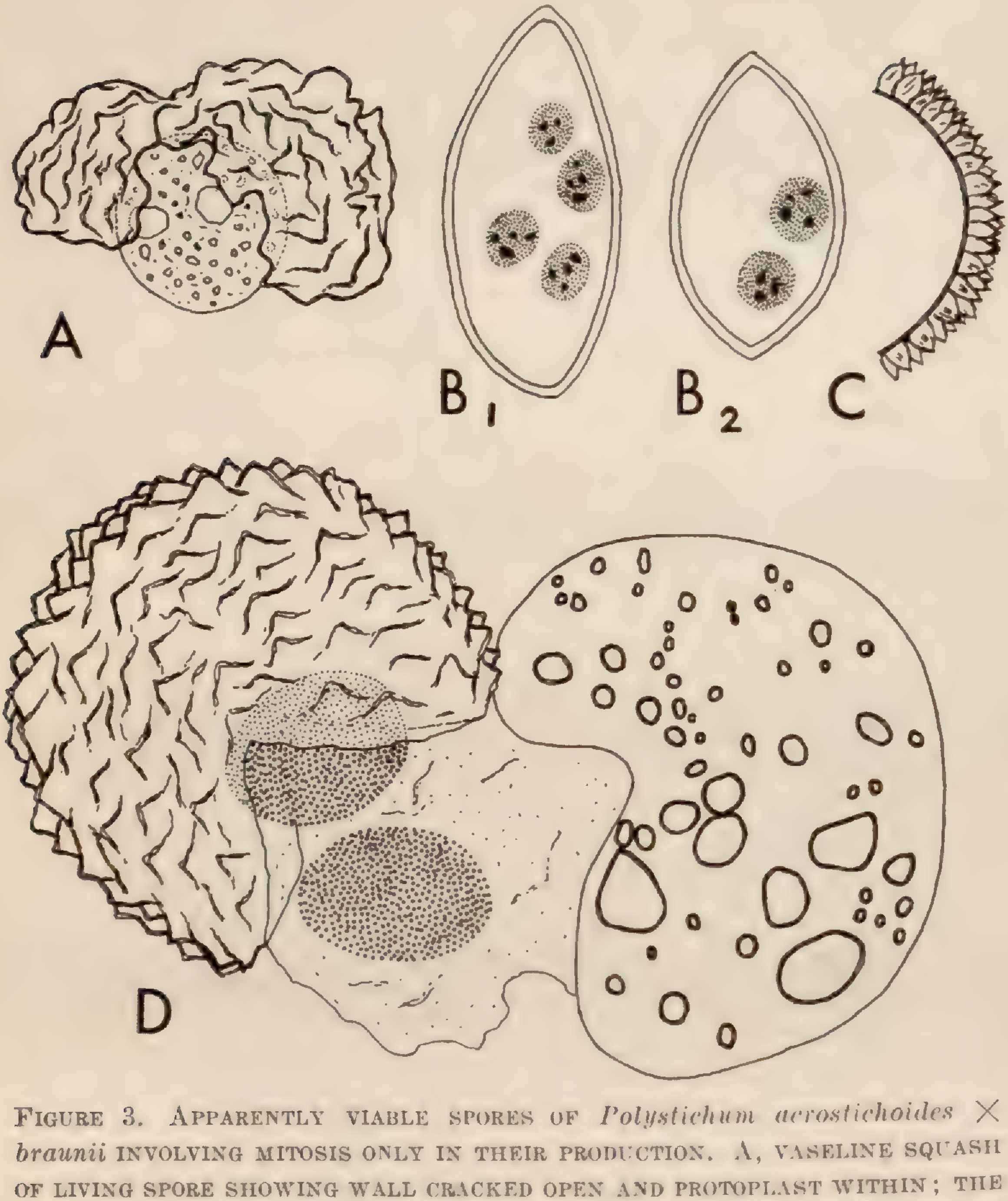


FIGURE 3. APPARENTLY VIABLE SPORES OF *Polystichum acrostichoides* × *braunii* INVOLVING MITOSIS ONLY IN THEIR PRODUCTION. A, VASELINE SQUASH OF LIVING SPORE SHOWING WALL CRACKED OPEN AND PROTOPLAST WITHIN; THE CIRCULAR BODIES ARE PROBABLY FAT BODIES; DIAMETER OF SPORE, CA. 60 MICRONS. B, FOUR-NUCLEATE (B_1) AND TWO-NUCLEATE (B_2) MITOTIC SPORES (SOMEWHAT PLASMOLYZED BY THE FIXATIVE); THE THICKENED PERIPHERIES ARE COMPOSED, EVIDENTLY, OF THE CELL MEMBRANES PLUS THE OUTERMOST CYTOPLASMIC LAYERS, AND THE SPORE WALLS ARE TORN AWAY. C, PORTION OF SPORE WALL FROM SPHERICAL SPORES, SHOWING THE SCALE- OR WING-LIKE PLATES THAT COMPOSE THE PERISPORE. D, GERMINATING SPORE (CA. 80 MICRONS IN DIAMETER) GENTLY SQUASHED IN ACETOCARMINE, WITH TWO NUCLEI VISIBLE IN CYTOPLASMIC MATRIX, AND LIQUID VACUOLAR MATERIAL AT RIGHT.

certain "sterile hybrids" it was noted that in addition to producing small, distorted, and commonly empty spores, these plants also formed in a single sporangium up to 16 giant spherical spores with well-developed walls. Such spores were observed in *Adiantum jordanii* × *pedatum*, *A.* × *curtissii* (presumably the "sterile" hybrid of *A. abscissum* and *A. verecundum*), *A.* × *biscayneanum* (the hybrid of *A. dentatum* and *A. verecundum*), *A.* × *trudellii* (*A. montanum* × *pinnatifidum*), *Polystichum acrostichoides* × *braunii*, and *P. acrostichoides* × *lonchitis*. The large round spores of these plants are fairly regular in form

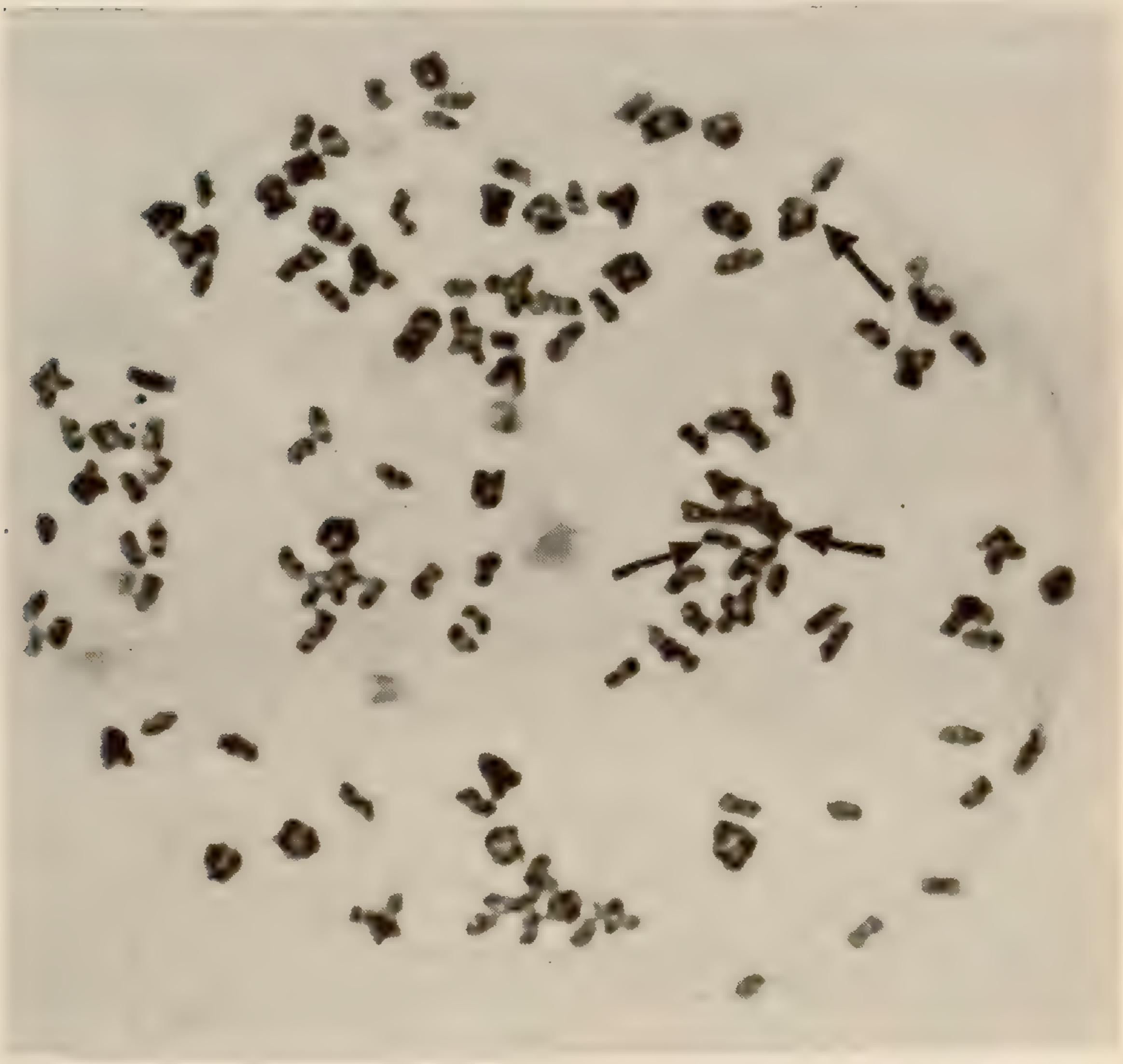


FIGURE 4. PHOTOGRAPH OF A MEIOTIC PROMETAPHASE SQUASH OF THE STERILE HYBRID, *Polystichum acrostichoides* × *braunii*. ARROWS INDICATE POSSIBLE TRIVALENTS.

and tend to contain four equal-sized normal-looking nuclei (Fig. 3).

The existence of these spores brought up several questions. How were they produced? Were they capable of germinating? What type of plant would they form? In an attempt to find the answers to some of these questions, an intensive study was made of one of the more peculiar hybrids available, namely, *P. acrostichoides* × *braunii*. The plant came from the garden of Mr. Harold Rugg of New Hampshire, and is believed to be one of the derivatives of the original hybrid discovered by Thompson and Coffin (1940) in the Green Mountains of Vermont.

Studies showed the hybrid to have quite an unusual cytological make-up. At meiosis, instead of the expected total number of 123 chromosomes (*P. acrostichoides*, $n = 41$ plus *P. braunii*, $n = 82$), conditions were found indicating that the hybrid has an extra genome. Two of the genomes more or less pair up, while two do not; therefore, during meiosis one sees about 41 bivalents and 82 univalents, or a total of 164 chromosomes (Figs. 4, 5A). Whatever the source of the extra genome, whether from a tetraploid stock of *P. acrostichoides* or by duplication of the normal diploid genome of that species in the hybrid, the plant would, by any standard criteria be assessed as "sterile," and the expectation of its producing viable spores would be little or none. Nevertheless, certain sporangia did form up to 16 giant spherical spores.

These large spores of the hybrid *Polystichum* were sown, and it was discovered that they were indeed viable, forming gametophytes which, at the outset, appeared normal. After the first month or so, however, the prothallia began to show irregular development. They grew mainly in an upright position, producing numerous rhizoids, antheridia, and archegonia on both surfaces. The antheridia produced active sperms, but the archegonia soon aborted. After several months the prothallia formed outgrowths. some of which became "secondary gametophytes" resembling the primary ones. Tertiary gametophytes formed on some of the

secondary gametophytes.

It should be emphasized that none of these gametophytes formed new sporophytes, and the same was true also of the other "sterile" hybrids that were listed above and grown on culture medium. Other normal species grown at the same time produced sporophytes. I attempted to expose some of the hybrid cultures to different lighting and temperature conditions but obtained no sporophytes. One might conclude, then, that the production of gametophytes by these sterile hybrids was of no consequence at all. However, this may not be the whole story, as will be discussed below.

In order to determine how the large viable spores were produced, paraffin sections of the sporangia were made. These sections showed that spore mother cell formation was normal, each sporangium having 16 diploid spore mother cells (as in a typical sexually reproducing plant) resulting from the divisions of the archesporial cell (Fig. 1C). At this point, however, two different courses of development can occur, one resulting in the formation of abortive meiotic spores and the other in the formation of the giant spores. Entirely one or the other process, or a combination of the two, may occur in a single sporangium.

The formation of numerous (up to 64) abortive spores occurs when the usual pathways of meiosis are followed. At metaphase the bivalents tend to cluster along the equator of the spindle and the univalents lie around the periphery (Fig. 5B). When the first and second division telophases occur, some of the chromosomes reform nuclei, while others remain outside as excluded chromosomes (Fig. 5C, D). The tetrads tend to form unequally, when tetrads are formed (Fig. 2B, C). Sometimes the meiotic spore mother cells do not even undergo cytokinesis following nuclear division, remaining as large spores with abortive distorted nuclei (Fig. 2E). Therefore, the spores are highly variable and abortive in appearance. I believe that they are mostly or entirely inviable, judging from their mode of formation and appearance.

As stated above, spore mother cell production in sporangia producing the large spores is normal; however, events following spore mother cell formation are not normal in that meiosis does not occur. The diploid nucleus of the spore mother cell may not divide at all, or it may undergo one or two *mitotic* divisions, resulting in one, two, or four diploid nuclei within a single spore mother cell (Fig. 3B). The original cell outline remains and the whole unit develops into a spherical spore which completely lacks tetrad markings, but which forms a normal-appearing wall and perisporial covering (Fig. 3A, C, D). (It should be noted here that the 16 diploid spore mother cells of a sporangium may all undergo meiosis forming what appear to be all abortive haploid

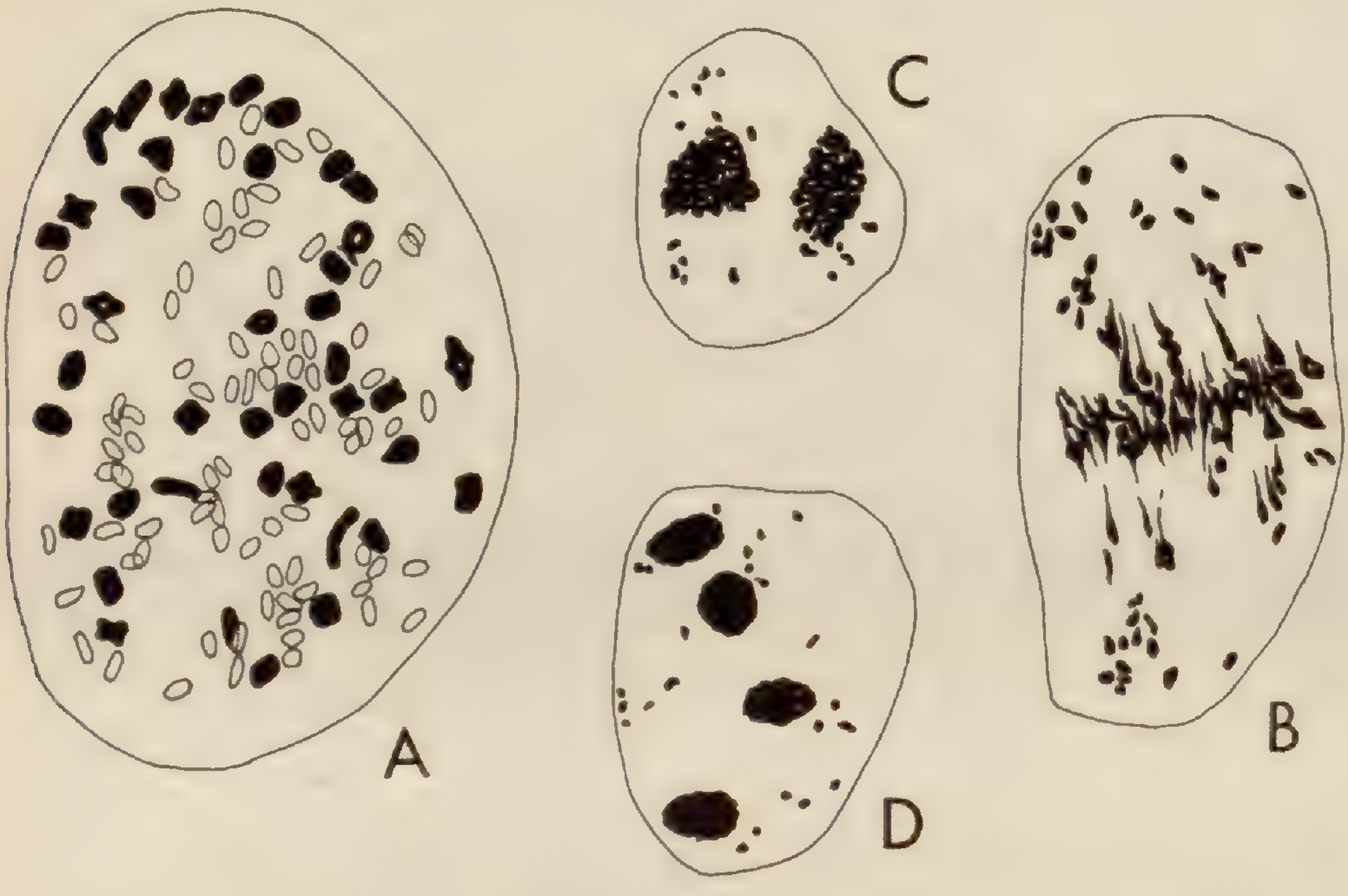


FIGURE 5. INTERPRETATIONS OF DIVISION FIGURES IN *Polystichum acrostichoides* × *braunii*. A, MEIOTIC PROMETAPHASE (SINGLES IN OUTLINE; PAIRS BLACKENED IN). B, DISTRIBUTION OF PAIRS AND SINGLES IN METAPHASE; MOST OF THE PAIRS LINED UP ON EQUATORIAL PLATE, SINGLES NEAR PERIPHERY OF CELL; SOME UNITS LAGGING BEHIND ON SPINDLE. C, FIRST DIVISION TELOPHASE WITH EXCLUDED CHROMOSOMES. D, SECOND DIVISION TELOPHASE WITH EXCLUDED CHROMOSOMES.

"meiospores" Fig. 2D), or they may all skip meiosis, forming 16 large round viable "mitospores" with varying numbers of diploid nuclei. More frequently, however, some of the 16 spore mother cells in a sporangium undergo meiosis while others do not, resulting in both abortive meiospores and viable mitospores within the same sporangium.) Thus, effectively, the spore mother cells simply turn into spores with varying numbers of diploid nuclei. In many respects, this type of spore formation resembles meiotic spore formation: The process occurs only after normal production of 16 spore mother cells. Nuclear divisions take place within the protoplast of the spore mother cell. Four nuclei (less often two or one) are produced. Spore wall formation follows; and the final product is a reproductive body that forms a gametophyte. It differs from meiotic spore formation in that the nuclear divisions are *mitotic* and that cell division following nuclear division does not occur, with the result that four separate spores, each with a single nucleus, are *not* formed. Therefore, the term "pseudomeiotic sporogenesis" has been coined for this type of spore reproduction (Fig. 1C). Related conditions have been reported by Mehra and Singh (1957) and by Bell (1960) in which spores are formed from spore mother cells. Both of their studies involved what were presumed to be autotriploids rather than allopolyploids, their plants being *Trichomanes insigne* forma β and *T. proliferum*. In their ferns, 32 spores were formed rather than 16 or fewer, as the protoplasts of the spore mother cells underwent division into two. Also, the process, as described by these authors, was a more regular phenomenon and occurred in all or most of the sporangia.

It is still not certain how the multinucleate spores germinate. Whether only one of the nuclei, if there are several, survives and produces the prothallium, or whether wall formation occurs within the large spore before the prothallium arises, is still unknown. In any event, it seems that only the giant spores produced gametophytes in the hybrid cultures studied.

The detailed studies of *Polystichum acrostichoides* × *braunii*

and the observations of apparently similar phenomena in other "sterile" hybrid ferns (listed above) suggest that, in spite of failure to obtain new sporophytes, the phenomenon may not be without significance. For example, if the gametophytes produced by "sterile" hybrids form sperms, this enables them to backcross with one or both of the parents. A number of peculiar and unexplained hybrid plants found under natural conditions may have resulted from such backcrossing. But there is a greater significance, and this involves the nature of the process of alternation of generations and the origin of apogamy. It is of considerable interest that the large spores are capable of (1) being produced by the plant, and (2) producing new plants of the gametophytic generation. Perhaps what has been observed is a stage in the process of the origin of obligate apogamy. The fact that all the plants involved in this study are almost certainly of hybrid origin is important, because it suggests the possibility that hybridity may be a necessary condition for spore production of the type described here, and in a more remote way underlies the origin of the obligate-apogamous life cycle. It is hoped that further work may shed light on these problems.

REFERENCES

BELL, P. R. 1960. The Morphology and Cytology of Sporogenesis of *Trichomanes proliferum* Bl. New Phytol. **59:** 53-59.

MANTON, I. 1950. Problems of Cytology and Evolution in the Pteridophyta. Cambridge University Press, Cambridge, England.

MEHRA, P. N., and G. SINGH. 1957. Cytology of Hymenophyllaceae. Jour. Genet. **55:** 379-393.

THOMPSON, R. H., and R. L. COFFIN. 1940. A Natural Hybrid between *Polystichum braunii* (Spencer) Fée and *P. acrostichoides* (Michx.) Schott. Amer. Fern Jour. **30:** 81-88.

NORTHWESTERN MICHIGAN COLLEGE, TRAVERSE CITY, MICHIGAN.

SHORTER NOTES

ROBERT P. ST. JOHN: 1869–1960.—With regret we learn from time to time that a member of the Fern Society who was active a few years ago, has dropped out of direct participation in the affairs of the Society owing to ill health or advancing age, and is rarely recalled by any save his or her closest friends. Such has been the history of Robert P. St. John, who joined the American Fern Society in 1934, and retained his membership over a decade. Available records do not disclose the year in which he withdrew from the Society, but Floral City, Florida, was given as his new address early in 1943 (FERN JOURN. 33: 40, 1943).

Robert P. St. John was born November 16, 1869, and died August 31, 1960. He was a gentle, rather reticent man who began serious study of ferns after he retired. He taught English in an academy in Penn Yan, New York, for a time, but few details about his activities prior to retirement are available.

In the early 1930's he and his brother, Edward P. St. John, began a survey of the ferns in northern Florida. The brothers lived just east of Floral City, and one of the best accounts of their field work, or possibly the only one, is given in their joint paper listed below. They wrote that they had covered 2,000 miles by automobile and several hundred on foot, in one year, in search of favorable fern habitats. The success of their efforts is attested by footnotes in J. K. Small's "Ferns of the Southeastern United States" crediting the first collection of several species of ferns in Florida to each of them. Robert was the first to collect *Trichomanes sphenoides*, and a peculiar variant of *Ophioglossum crotalophoroides* in the state.

After he had learned the identity of nearly a hundred species of ferns native in Florida, without forgetting those he knew farther north, he began to guide others to some of his favorite collecting grounds, and to send living plants and notes on the life history, ecology, and characteristics of the rarer ones to his friends. He planted many of the rarer ferns in the garden at

Floral City, and watched them as they developed, competed with aggressive, weedy ferns and other plants, or succumbed and disappeared. Whatever the outcome, he noted the success or failure of each species to adapt to garden conditions.

One of the noted botanists to profit from his meticulous study of Florida ferns in field and garden was John K. Small. Dr. Small drew heavily on the intimate knowledge of Edward and Robert, and the latter contributed the text for the genus *Thelypteris*, excepting the description of one new species prepared by Small, and provided the descriptions of the scales on the rhizomes and stipes of the first ten of the fifteen species of *Dryopteris* included in Small's "Ferns of the Southeastern United States."

A search through back numbers of the AMERICAN FERN JOURNAL revealed the following articles and contributions by Robert P. St. John. There is no assurance that this list is complete.

ST. JOHN, EDWARD P., AND ROBERT P. ST. JOHN. 1935. Fern Study in Central Florida. Amer. Fern Jour. **25:** 33–44. [This included the new combination, *Pteris latiuscula* var. *pseudocaudata* (Clute) E. P. & R. P. St. John].

ST. JOHN, ROBERT P. 1936. Ferns of the Vicinity of New York, by J. K. Small. (Review). Amer. Fern Jour. **26:** 16–20.

———. 1938a. Text for the genus *Thelypteris* in, Ferns of the Southeastern United States, by J. K. Small. [Included descriptions of four new species, *T. ovata*, *T. saxatilis*, *T. unca*, and *T. versicolor*, and three new combinations.]

———. 1938b. Guide to Eastern Ferns, by Edgar T. Wherry. (Review). Amer. Fern Jour. **28:** 31–33.

———. 1943. Guide to Eastern Ferns, ed. 2, by Edgar T. Wherry. (Review). Amer. Fern Jour. **33:** 76–77.

Unfortunately, as his health became less robust, Robert St. John had fewer opportunities to participate in the field work he loved, and even found it hard to care for the garden he and Edward had established and cherished. His daughter, Mrs. Norman L. Cutler, wrote that Robert St. John shifted his attention from ferns to mushrooms during the last years of his life, for he could search them out more easily than he could the ferns growing in more remote places. In one of her letters she wrote,

"I believe his interest in ferns contributed more than anything else to his happiness in the latter part of his life. . . . Dad maintained his interest in Nature Study and enjoyed life fully to the end."

She also said that if he could know about mention of his contributions to our knowledge about ferns in the FERN JOURNAL, that she could ". . . just see how he would have grinned with modest pride."

Robert St. John's modesty obviously outweighed his pride. His greatest joy was in sharing his treasured ferns and their habitats with others.—I. L. W.

Long-time members of the Society in the Middle Atlantic States will be saddened to learn of the death last November of Dr. Everett G. (Jimmy) Logue. One of his hobbies was the raising of ferns from spores, in which he was eminently successful, and many a local fern garden was enriched by plants he contributed. He had a charming personality and a fine sense of humor, which stood him in good stead during recent years of domestic difficulties and ill health.—(E. T. W.)

A DECORATIVE FERN SCREEN.—In order to stimulate interest in ferns in the Washington, D. C., area and to promote the Fern Valley at the United States National Arboretum, Mrs. Benjamin Grant and Mrs. Morrill B. Donnald made a large translucent screen displaying actual specimens of decorative native ferns. The screen (Fig. 1) was constructed of pre-cut paneling, which was lacquered black. Then specimens pressed as thin as possible were mounted on one layer of clear plastic and covered with a second layer, the plastic used being the tough but pliable kind developed for greenhouse use. The plastic was then sprayed with a clear lacquer to produce a decorative translucent effect.

The screen was displayed at the Central Atlantic Regional Conference of the National Council of State Gardens Clubs in October, 1958, and at the National Capital Flower and Garden Show in Washington, D. C., in March, 1959.—EDITH BITTINGER, *3103 O Street, N. W., Washington, D. C.*

SCREEN MADE OF PRESSED FERNS MOUNTED BETWEEN SHEETS OF PLASTIC

FERNS IN CULTIVATION, V. GROWING MAIDENHAIR FERNS.—In southern California most failures in growing maidenhair ferns (Adiantums) come from trying to grow species out of doors that will not thrive unprotected in our climate. The Los Angeles area is too hot and dry in the summer and too cold in the winter for *Adiantum hispidulum*, *A. formosum*, and the various cultivars of *A. cuneatum*. These plants need a glasshouse where heat can be provided in the winter and the humidity controlled in the summer.

The best species for outdoors is the common Venus-hair Fern, *Adiantum capillus-veneris*, a fern which is native in southern California as well as many other parts of the world. It is the nearest to evergreen in our climate. Some gardeners wonder why their ferns have turned brown after a hot spell; it is because the heat has encouraged the spores to ripen, and the fronds have thus gone through their reproductive cycle prematurely. I cut back *Adiantum capillus-veneris* completely in September and lightly mulch the plants. In a short time new fronds appear which remain green all winter. In February, I again cut them back to the ground, mulch them again, and soon they are again lovely specimens. They will be good all summer, unless we have an ususually hot spell, as we did in June a couple of years ago; at that time I again cut them back, but usually they require cutting only twice a year.

Many gardeners who complain of bad luck with maidenhairs notice that neighbors have beautiful plantings along the north side of their houses. The next time you notice a beautiful planting on the north side of a wall, look and see if the roots aren't traveling along the cement foundations. This is the secret. This fern needs limestone. If limestone foundations are not available, a substitute can be the placing of pieces of old cement in the ground and planting the maidenhairs alongside, where the roots can travel among the pieces. In place of cement, one can use groundup oyster shells, which are especially suitable in pots. I use about a half cup to a six inch pot.—SYLVIA LEATHERMAN, *2637 North Lee Avenue, El Monte, California.*

TRICHOMANES BOSCHIANUM IN ARKANSAS.—In January, 1962, Dr. Delzie Demaree of Hot Springs, Arkansas, sent me for identification of a number of ferns that he had collected over the past couple of years. Among his specimens was a fine collection of *Trichomanes boschianum* Sturm, a species new to the state of Arkansas and constituting a considerable extension of the known range, as given by Mohlenbrock and Voigt (1959). Conrad Morton of the United States National Museum suggested that I bring this record to the attention of other botanists.

The Demaree material of this filmy-fern was sufficient for me to divide it, and specimens are now on deposit in several herbaria (GH, MICH, PENN, US). The fronds of these specimens are all small, ranging from 4 to 6 cm. in length, and are thus shorter than the minimum of 8 cm. given by Mohlenbrock and Voigt (1959, p. 78). The tips of the segments are mostly acute rather than blunt. I have examined all of the specimens carefully, and I can find no evidence of sori. The colony apparently was made up entirely of sterile plants, which formed a large mass of vigorous, intertwined rhizomes. This mass grew "over the top and sides of a seepy overhanging bluff," according to Dr. Demaree's label.

Dr. Demaree discovered this colony on August 20, 1961, in the Greers Ferry Dam Area, Heber Springs, Cleburne Co., Arkansas. This area is now being flooded in connection with the Greers Ferry Reservoir Project which will produce a lake approximately 50 miles long along the Little Red River. A brochure on this project, which includes a map of the locality at which the fern was found, has been published by the United States Army, Little Rock, Arkansas. The filmy fern grows nearly a mile northeast of the dam itself, according to information provided by Dr. Demaree (letter, February 27, 1962), and is not far from the newly built access road. The plants grow on a tall overhanging bluff just to the south of a small stream at the place where it enters the lake. Dr. Demaree writes that fortunately "this bluff will be about fifty feet above the water line when the lake

is filled—." Thus the colony will be saved.

The discovery reported here extends the known range of *Trichomanes boschianum* roughly 235 miles from the nearest locality northward in Illinois and 250 miles from the one eastward in Alabama.—W. H. WAGNER, JR., *Department of Botany, University of Michigan, Ann Arbor, Michigan.*

REFERENCE

MOHLENBROCK, R. H., and J. W. VOIGT. 1959. A Study of the Filmy Fern *Trichomanes boschianum*. Amer. Fern Jour. **49**: 76-85.

TRICHOMANES BOSCHIANUM IN MADISON COUNTY, ARKANSAS.—*Trichomanes boschianum* Sturm was collected February 4, 1962 (*M. Clark 1397*, UARK) in the southeast portion of Sec. 1, T. 13N., R. 25W., Madison County, Arkansas, 6.5 miles southeast of Pettigrew. The collection site, elevation 1600 feet, is located on the south slope of the Boston Mountains in a deep ravine, locally called "Beech Herrican" (Hurricane). It is 2.5 miles below the divide which has an elevation of 2350 feet in this area. The narrow valley is formed by Beech Creek flowing southeast to Little Mulberry Creek, and is within the boundaries of the Ozark National Forest. The ecological description by Braun (1950, pp. 164, 170-76, 494) of protected slopes of deep ravines of the Boston and Ouachita mountains, where numerous southern and mesophytic Appalachian species occur, seems applicable here. The dominant canopy tree is *Fagus grandifolia; Nyssa sylvatica*, *Liquidambar styraciflua*, *Quercus alba*, *Prunus serotina*, and *Carya* spp. occur also. The understory trees observed are *Magnolia tripetala*, some 40 feet high, *Cornus florida*, and *Ostrya virginiana*. *Alnus* sp. and *Carpinus caroliniana* grow along the streams, and *Rhododendron* sp. (azalea) occurs as a shrub.

The first colony of *T. boschianum* observed covers a moist area 52 feet long and 2-3 feet high on the vertical wall below a 2-4 foot overhang at the base of an east-facing bluff of basal Atoka sandstone. Elevations and geologic interpretations are by the author's husband, J. M. Clark. The fern, collected in mid-winter, was actively growing as evidenced by the developing fronds and

intact sporangia at the base of many of the receptacles. The fronds (stipe and blade) vary in length from 3-17 cm. At a later date, the east-facing bluffs along the stream were explored for a distance of one mile. Five additional colonies, one 20 feet long and the others smaller, were found. Specimens are on file at the University of Arkansas Herbarium in sufficient quantity to supply requests by other herbaria.

Madison County is the second station for the filmy fern in Arkansas, and is about 90 miles west and 20 miles north of the Cleburne County station discovered by Delzie Demaree and reported in the preceding note by W. H. Wagner, Jr.—MAXINE B. CLARK, *Fayetteville, Arkansas.*

REFERENCE

BRAUN, E. LUCY. 1950. Deciduous Forests of Eastern North America. The Blakiston Co., Philadelphia.

ANOTHER FLORIDA LOCALITY FOR PALTONIUM LANCEOLATUM.—One of the fern rarities of Florida is *Paltonium lanceolatum*, a *Polypodium*–like fern with strap-shaped leaves and with the sporangia borne in a narrow, elongate, submarginal band at the narrowed apex of the blades. It has been known in Florida only from Old Rhodes Key and Elliotts Key. For some time I have searched the hammock-covered parts of Elliotts Key and Key Largo for it, but without success. Last year, a Mr. Pendergast found it on Key Largo and brought it to an orchid dealer for identification. I saw it there and learned that Pendergast had found it in a mangrove swamp. With this lead, I had no trouble in finding it myself, growing on the top of red mangroves (*Rhizophora mangle* L.) in a swamp on the northeast coast of Key Largo. The mangrove trees here are about eight to ten feet tall, and the fern is best found by climbing through the tops of the trees. The plants were barren at the time I found them, but I brought a plant home and have had it in cultivation since early in November, 1960. It has done well, and this year produced several fertile fronds, one of which has been collected and deposited in the U. S. National Herbarium.—C. E. DELCHAMPS, *9470 Toni Drive, Miami, Florida.*

MAKING BASKETS FROM FERN STIPES.—In Taiwan there is a local industry making woven baskets from the stipes and rachises of ferns of the family Gleicheniaceae. These ferns are locally in abundant supply, being common and widely distributed in the mountainous areas of Taiwan. Plants of both the genera *Dicranopteris* and *Gleichenia* are in use.

The stipes and rachises of *Dicranopteris linearis* and *D. warburgii* are smooth and glossy and have a natural shiny brown color. After drying and removal of the leafy pinnae, they are ready for weaving without further treatment. Baskets made from them have a very artistic appearance (Fig. 1) ; they are used for carrying fruits and other light objects.

On the other hand in the case of *Gleichenia longissima* the outer cortex is peeled off by hand and the material used in weaving is therefore not the whole stipe and rachis but only the stelar part. This is rough and not smooth and shiny like the stems, but it is much more durable and can support a heavier load. It is dyed a brown color before the weaving so the finished baskets are less ornamental (Fig. 2).—EUGENE YU-FENG SHEN, *Department of Botany, National Taiwan University, Taipei, Taiwan, China.*

Recent Fern Literature

The book "How to Know Ferns" by Frances T. Parsons, published in 1899, has always been a popular one with amateur botanists and fern students. Although the nomenclature is now out of date, the book still has a good deal of interest. It has been reprinted recently, and is available from Dover Publications, Inc., 180 Varick St., New York 14, N. Y. ($1.25).—C. V. M.

A booklet (written in Spanish) contains 67 pages of keys to the families, genera and species of ferns and fern-allies native to Uruguay (LeGrand, Diego, and Atilio Lombardo. 1958. Pteridophyta (in Flora del Uruguay) 1–67). It provides brief but carefully worded descriptions of the taxa, and 32 full-page plates of line drawings illustrating most of the species included.





Fig. 1. Basket Woven from Whole Stipes and Rachises of Dicranopteris linearis.

Fig. 2. Basket Woven from Steles of Stipes and Rachises of Gleichenia longissima.

The Spanish is simply written and is read easily by anyone having a moderate familiarity with the language.

The sales price of the booklet is not given, but inquiries can be addressed to: Museo Nacional de Historia Natural, Casilla de Correo 399, Montevideo, Uruguay. Dr. C. Diego LeGrand is Director of the Museum.—I. L. W.)

"HARDY FERNS AND THEIR CULTURE"—This useful pamphlet, originally published in 1940, has been reprinted and is again available for 25 cents from The New York Botanical Garden, Bronx Park, New York 58, New York.—C. V. M.

"FERNS OF THE SIERRA"[1] by Robert J. Rodin keys and describes in a popular manner all the ferns of the central part of the Sierra Nevada of California. Most of the species are illustrated by photographs of dried specimens or of plants *in situ*, many of the latter perhaps the first published photographs of the species concerned, such as the fine photograph of *Selaginella hansenii*. In general the nomenclature follows that of Maxon except in *Polypodium* and a few other genera. This is a commendable work that students of Californian ferns will not want to be without.—C. V. M.

THE FERN GUIDE BY EDGAR T. WHERRY[2]—The present book by one of our foremost authorities on North American ferns represents, in a sense, a third edition of his well known "Guide to Eastern Ferns." The illustrations, however, are all new ones, the area covered is much expanded and the comparable text is thoroughly revised, so that it is more accurately regarded as a new book. It is one that can be highly recommended to anyone with an interest in ferns.

The book is of a compact size which is an important feature in making it a true field manual. It consists of an introductory portion on the fern plant, cytology of ferns, spores, ecology,

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[1]Yosemite Nature Notes 39: 45-124. 1960. Available from National Park Service, Yosemite National Park, California.

[2]Edgar T. Wherry. (illustrated by James C. W. Chen). 1961. The Fern Guide, Northeastern and Midland United States and adjacent Canada. Doubleday & Co., Inc., Garden City, New York. 318 p., 118pl.

and culture in the garden. A bibliography of other current fern literature is given and the brief glossary of technical terms is also conveniently placed at the front of the book. There are excellent keys for the identification of the families, genera and species. The principal portion of the book is devoted to the 36 genera and some 130 species that are recognized as growing in the area covered. This region is approximately that of New Brunswick westward to southeastern Manitoba and south to eastern Kansas, Missouri, Kentucky and Virginia. Each species is illustrated by one or more line drawings, each is well described and information is given about its distribution, ecology, and, when appropriate, its use in the garden. At the back of the book are indices, a chapter listing the persons who have described ferns and another one on the meaning of the names of ferns.

An important feature of the book is the frequent discussion of problems in the classification and the naming of the species or genera. Too often the current state of our knowledge about plants is presented as if it were in final form and there is little or nothing remaining to be done. Dr. Wherry's refreshing viewpoint will serve to stimulate observations and study.

Dr. Wherry is to be congratulated upon his latest book which is one that all members of the Fern Society will wish to have. He has brought his broad knowledge of living ferns and of their classification effectively to bear in this manual. It is perhaps appropriate to mention here his generosity to this Society, for he has arranged that the royalties are to be received by the American Fern Society.—ROLLA TRYON.

Two[1,2] technical papers issued in July, 1961, support the hypothesis that *Asplenium pinnatifidum* is a hybrid deriving one genome from *A. rhizophyllum* and one from *A. ebenoides;*

---

[1]Wagner, W. H. Jr., and Kathryn E. Boydston. 1961. A New Hybrid Showing Homology Between *Asplenium ebenoides* and *A. montanum*. Brittonia **13:** 286–289.

[2]Smith, Dale M., Truman R. Bryant, and Donald E. Tate. 1961. New Evidence on the Hybrid Nature of *Asplenium kentuckiense*. Brittonia **13:** 289–292.

and that *A. kentuckiense* also is a hybrid deriving one genome from *A. montanum,* another from *A. platyneuron* and still another from *A. rhizophyllum.*—(I. L. W.)

Notes and News

NEW KIND OF FERTILIZER.—Fern growers may like to try a stick fertilizer, probably available now in most garden supply stores, called "Gard-N-Stik", put out by Gansco Products, Ltd., 527 Madison Avenue, New York 22, N. Y. A wooden applicator makes holes at the base of plants and sticks of the fertilizer are inserted deep in the ground. In this way it is stated that balanced feeding takes place over a long period and there is no danger of root burning. The formula called 5-4-4 might be best for ferns. —C.V.M.

SPORES WANTED.—The University of California Botanical Garden, Berkeley, California, desires spores or living plants of the genera *Loxsoma, Loxsomopsis, Helminthostachys, Macroglossum, Archangiopteris, Christensenia, Hymenophyllopsis, Plagiogyria, Matonia,* and *Phanerosorus.* Most of these are rare plants unknown in cultivation, but perhaps some members or readers of the Journal living in distant regions may be able to collect material.

LYCOPODIUM SPORES, FIVE DOLLARS PER POUND.—A letter which reversed the usual direction of inquiry came recently from the Smithsonian Institution. Could I provide information as to a source of *Lycopodium* spores? The question proved to be very easily answerable during the course of a visit to New York City. The first place I tried, a Third Avenue drug store which looked as if it had been in its location for a good long time, gave me a reference to the firm of S. B. Penick & Co., dealers in a wide variety of herbs and other plant products. I called the New York office at 100 Church Street and spoke with a Mr. Meyer who quoted the price cited in the title.

Mr. Meyer told me that the firm's present customers were foundries but he could not say how foundries used the spores.

My guess could be that the spore powder may serve as a coating for some special type of casting. Does any reader have the exact answer? One wonders whether these spores are still used for any of the earlier applications, as in fireworks or tracer bullets. The photo-flash guns of the earlier photographer have been supplanted by aluminum flash bulbs. The Third Avenue druggist told me that he had not stocked *Lycopodium* spores for 20 years. The spores were once used in various types of powder dressings and to coat sticky pills. Dr. Wherry has written in this Journal of their potential inflammatory effect in the former case. Another question that comes to mind is where a collector would go to collect spores by the pound.—RALPH C. BENEDICT, *Pilot Knob, New York.*

American Fern Society

AMERICAN FERN SOCIETY SUMMER FIELD TRIP, JULY 12-14, 1962.—The Northeastern section of the American Fern Society is planning a field trip in Vermont. The headquarters will be the Wallingford Inn, Wallingford, Vermont, and participants will assemble on the evening of Thursday, July 12, and spend the next two days in the field. New and interesting areas in the vicinity of Wallingford will be visited. Evening programs are being arranged under the direction of Dr. Benedict. Please inform Dr. Benjamin R. Allison, 26 Ives Road, Hewlett, New York, if you plan to attend. Reservations should be made directly with the Wallingford Inn or at neighboring motels.

WESTERN FIELD TRIPS OF THE AMERICAN FERN SOCIETY.—A joint field trip is being co-sponsored by the American Fern Society, the American Society of Plant Taxonomists, the American Ecological Society, and the Pacific Section of the Botanical Society of America. This trip is scheduled for August 24-25, the Friday and Saturday immediately preceding the annual meetings of the American Institute of Biological Sciences, and will be led by Dr. Kenton L. Chambers and Miss La Rea Dennis. It will take a circular route from Corvallis, Oregon, to Newport,

Waldport, Florence, and return. It will cover a variety of habitats, including Coast Range forest, coastal marsh, sand dunes, and *Darlingtonia* bogs. Travel will be by private cars, on main highways, and motel and eating accommodations will be available.

Participants can reserve University housing for any time beginning August 20, as is explained in the Pre-registration and Housing Information published in the April 1962 issue of *The AIBS Bulletin*. Room rental there is $2.75 per person per night (except infants) for double occupancy; $3.75 for single occupancy. This would be an added expense during Friday night, August 24, for participants who enter the University housing before the trip. It is likely that family camping space near Corvallis will be extremely limited and motel space difficult to obtain just prior to the meetings.

Those interested in participating in this field trip should submit the following information to Dr. Kenton L. Chambers, Department of Botany, Oregon State University, Corvallis, Oregon, before August 1, 1962: Name, address, number in group, type of transportation, space (if any) for additional passengers, and requests for motel reservations for August 24 if needed. Further questions concerning this field trip may be addressed to Dr. Chambers.

POST-MEETINGS FERN FORAY—A foray sponsored solely by the Fern Society, to run from August 30 to September 1, will include the Fairview-Bohemia District and Crater Lake in its itinerary. Information and registration blanks will be sent to each member in July. Dr. William H. Baker, University of Idaho, Moscow, Idaho, will be the leader.

NEW MEMBERS

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---

*Names preceded by an asterisk are those of members who joined the Society in 1960, but the names were inadvertently omitted from Volume 51, Number 1.

CHANGES OF ADDRESS

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Suggestions to Contributors to the American Fern Journal

1. Authors of papers submitted to the *American Fern Journal* should consult the *Style Manual for Biological Journals* (1960) and be guided by its examples.

2. The "name-and-year" system for bibliographic references will, except in exceptional cases, be used. (See Literature Cited below for an example).

3. Authors are encouraged to use the journal abbreviations set forth by Schwarten and Rickett (1958, 1961).

4. Abbreviations of names of herbaria will be those listed by Lanjouw and Stafleu (1959).

5. Reports of chromosome numbers will not be accepted unless documented.

6. The use of footnotes and tabular matter should be kept to a minimum.

7. All manuscripts submitted for publication should be typed, double-spaced, and have ample margins.

8. Reprints should be ordered when galley proof is returned to the Editor. An order blank will be included with the galley proof.

Literature Cited

American Institute of Biological Sciences, Committee on Form and Style of the Conference of Biological Editors. 1960. Style Manual for Biological Journals. American Institute of Biological Sciences. Washington, D. C. 100 p.

Lanjouw, J., and F. A. Stafleu. 1959. The Herbaria of the World. Index Herbariorum, Regnum Veg. **15**: 1-249.

Schwarten, L., and H. W. Ricket. 1958. Abbreviations of Titles of Serials Cited by Botanists. Bull. Torrey Club **85**: 277-300; 1961. Supplement I. Ibid. **88**: 1-10.

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VOL. 52 JULY-SEPTEMBER, 1962 No. 3

American Fern Journal

A QUARTERLY DEVOTED TO FERNS

Published by the

AMERICAN FERN SOCIETY

C. V. MORTON

IRA L. WIGGINS

JOHN H. THOMAS

ROLLA M. TRYON

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MISSOURI BOTANICAL GARDEN RECEIVED OCT 29 1962

The American Fern Society

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Back volumes $3.00 each; single back numbers 75 cents each; Cumulative Index to vols. 1-25, 25 cents. Ten per cent discount on orders of six volumes or more.

Changes of address, applications for membership, subscriptions, orders for back numbers, and other business communications should be addressed to the Treasurer, Dr. Richard L. Hauke, Department of Botany, University of Rhode Island, Kingston, Rhode Island. Members and subscribers should allow two months for changes in address to take effect.

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Dr. W. H. Wagner, University of Michigan, Ann Arbor, Mich.

A regular loan department is maintained in connection with the library and herbarium. Members may borrow books and specimens at any time, the borrower paying all postal or express charges. The pages of the Journal also are open to members who wish to arrange exchanges; a membership list is published at intervals, to assist those interested in obtaining specimens from different localities.

American Fern Journal

VOL. 52 JULY-SEPTEMBER, 1962 No. 3

Fern Sources in the United States

D. G. HUTTLESTON

Since I, as secretary of the American Fern Society, receive frequent requests for sources for specific ferns, I undertook to find United States sources for as many ferns as possible. I asked the membership of the American Fern Society for addresses of nurseries, and I want to express my great appreciation to the large number of members who responded.

I next wrote to each of the nurseries, asking for lists of ferns. Of over one hundred nurseries, only sixty-nine responded. Originally I had intended to write separate articles for hardy and tender ferns. However, because some nurseries carry both, and because some ferns are borderline in hardiness, I decided to combine all into one article.

There are several things that should be borne in mind by persons reading the article. The author is by no means a fern specialist, particularly for exotic species, so that the nomenclature is suspect. I have had to assume that the names used by nurseries were correct as it would have been impossible to check identifications. In many cases different nurseries carry the same fern under different names. In those cases where I was fairly certain of this I list them under one name even though this may cause some confusion in ordering. However, I expect to apprise the nurseries of this in the hope of solving the problem. For northeastern ferns, I have followed the nomenclature found in Dr. Wherry's *The Fern Guide*.

Nurseries which carry only two or three very common species have not been included. On the other hand, a few cash-and-

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carry nurseries (indicated by C & C) are included if they handle a number of unusual species. All nurseries listed are retail, mail order firms unless otherwise indicated (W = wholesale only; W & R = wholesale and retail) and sell plants only, except those marked with S (spores only) or S & P (spores and plants). The three or four letters preceding the name of each nursery constitute the code designation of that nursery. For nurseries included in *Plant Buyer's Guide*, 6th Edition, the code designations are the same. The groups of three or four letters following the name of a fern are the code designations of nurseries listing that fern.

NURSERIES LISTING FERNS

AlMj Mose Jacobs C & C
1507 16th Avenue S.
Birmingham 5, Ala.

CaA Antonelli Brothers
2545 Capitola Road
Santa Cruz, Calif.

CaAw Alfred W. Roberts W
10136 National Blvd.
Los Angeles 34, Calif.

CaCj California Jungle Gardens
11977 San Vincente Blvd.
Los Angeles 49, Calif.

CaDb Dorothy S. Behrends S
442 Orpheus Avenue
Encinitas, Calif.

CaEm El Modeno Gardens
19140 East Chapman
P. O. Box 212
El Modeno, Calif.

CaFl Fuchsia Land Nursery
Centinela and Wagner
Los Angeles 66, Calif.

CaHr Harry K. Roberts S & P
P. O. Box 64
Guerneville, Calif.

CaLe Leatherman's Gardens
2637 No. Lee Avenue
South El Monte, Calif.

CaLs La Sumida C & C
3880 State Street
Santa Barbara, Calif.

CaNw Northwest Ferns
Box 257
Fort Bragg, Calif.

CaSn Schmidt Nurseries C & C
355 Lambert Avenue
Palo Alto, Calif.

CaWe Wesco Tropicals W
Route 4, Box 409n
Lilac Road
Escondido, Calif.

CaWo Wilson Orchids
490 Beverly Ave.
San Leandro, Calif.

CnLo Logee's Greenhouses
55 North Street
Danielson, Conn.

CnRh Ruth Hardy's Wildflower Nursery
Falls Village, Conn.

CnWf White Flower Farm
Litchfield, Conn.

Colg Iliff Garden Nurseries
4750 E. Iliff Avenue
Denver, Colorado

FlA Alberts & Merkel Bros., Inc.
Boynton Beach, Florida

FlBl Bruce H. Beeler C & C
La Casa Verde
Route 1, Box 40
Homestead, Florida

FlFa Fantastic Gardens
9550 S. W. 67th Ave.
Miami 56, Florida

FlHw Mrs. Harry Wade
5762 Timuquana Road
Jacksonville, Florida

IlAf Amling's Flowerland C & C
8900 W. North Avenue
Maywood, Illinois

IlLg Lounsberry Gardens
Oakford, Illinois

InHe Henderson's Botanical Gardens
Route 6
Greensburg, Indiana

InYo Yoars Greenhouse
Bunker Hill, Ind.

KaTp Tropical Paradise Greenhouse
8825 W. 79th Street
Overland Park, Kansas

MaAa Arthur Allgrove
North Wilmington, Mass.

MaGw Garden in the Woods
South Sudbury, Mass.

MaLe Leslie's Wild Flower Nursery
30 Summer Street
Methuen, Mass.

MdBm Blue Mount Nurseries
Blue Mount, Maryland

MeMg Merry Gardens
Camden, Maine

MiBu Burgess Seed and Plant Co.
Galesburg, Michigan

MiS Harry E. Saier S & P
Dimondale, Michigan

MnFe Ferndale Nursery & Greenhouses W & R
Askov, Minnesota

MnOg Orchid Gardens W & R
Route 1, Box 290
Grand Rapids, Minn.

MoHm Ruth Mooney
Hi-Mountain Farm
Route 1, Box 29
Seligman, Mo.

MtFr Frank H. Rose W & R
1020 Poplar Street
Missoula, Montana

NcBr Gardens of the Blue Ridge
Ashford, McDowell County
North Carolina

NcTl The Three Laurels
Marshall, Madison County
North Carolina

NhFs Francis M. Sinclair
19 Green Street
Exeter, N. H.

NhSk Stella J. Skiba S & P
Bluff Road
Salem Depot, N. H.

NhW Isaac Langley Williams W
Exeter, N. H.

NjB Barrington Greenhouses
860 Clement Bridge Road
Barrington, New Jersey

NjGf Robert H. Gaede C & C
Fernglen Gardens
27 Werimus Brook Rd.
Saddle River, N. J.

NjKs Kelsey Nursery Service
Highlands, N. J.

NjPs Pearce Seed Company S & P
Moorestown, N. J.

NjR Julius Rochrs Co. W & R
Rutherford, N. J.

NjWm W. A. Manda W, C & C
42 Old Short Hills Rd.
Livingston, N. J.

NyJs John Scheepers W & R
37 Wall Street
New York 5, N. Y.

NyTw Thomas M. Wood
Constantia, N. Y.

OhRn Rocknoll Nursery
Morrow, Ohio

OhSh Spring Hill Nurseries W & R
Tipp City, Ohio

OhWm Wayside Gardens
Mentor, Ohio

OrKf Kramers
4543 S. E. Harney Dr.
Portland 6, Oregon

PaHg Hildemere Gardens C & C
U. S. Route 1
Wawa, Penn.

PaVw Vick's Wildgardens
Gladwyn, Penn.

PaWr Wake Robin Farm
Route 1, Box 33
Home, Penn.

ScGp George W. Parks Seed Co. S
Greenwood, S. C.

SdPg Claude A. Barr
Prairie Gem Ranch
Smithwick, S. D.

TxNh Ralph Pinkus
Northhaven Gardens
Northhaven Road
Dallas, Texas

VeFh F. H. Horsford
Charlotte, Vermont

VeGe Gardenside Nurseries, Inc.
Shelburne, Vermont

VeP Putney Nursery, Inc.
Putney, Vermont

VeSc Sky-Cleft Gardens
Camp Street Extension
Barre, Vermont

WaIr Mrs. Isitta M. Renton
Route 1, Box 111
Snoqualmie, Wash.

WaJv Jamieson Valley Gardens
Route 3, Box 648
Spokane, Wash.

WaTh Thurman's Gardens
Route 2, Box 259
Spokane, Wash.

WiWa Woodland Acres Nursery
Crivitz, Wisconsin

KEY TO SUPPLIERS, BY SPECIES AND CULTIVARS

ACROSTICHUM

aureum KaTp

ADIANTUM

'Altadena' CaAw
bellum CaDb, CnLo
capillus-veneris AlMj, CaNw, CnLo
caudatum CaDb, CaEm, CaFl, CaLe, CaSn, NjR
croweanum CaDb
cuneatum CaDb, CaEm, CaFl, CaLe, CaLs, CaSn, IlAf, KaTp, NjR, ScGp
—'California' CaDb
—'Fritz Luthi' CaDb, CaEm, CaLe, KaTp
—var. gracillimum CaSn
—'Grandiceps' CaDb
curvatum KaTp

ADIANTUM (Cont'd.)

decorum 'Pacific Maid' CaA, CaDb, CaFl, CaSn, MeMg
dissectum CaDb
formosum CaLe, CaSn
fragrantissimum CaFl
gracillimum CaDb, KaTp
hispidulum CaDb, CaEm, CaFl, CaLe, CaLs, CaSn, CnLo, FlA, KaTp, NjB
jordanii CaNw
'Old Triumph' CaDb
pedatum AlMj, CaA, CaAw, CaEm, CaFl, CaLs, CaNw, CaSn, CnRh, CnWf, CoIg, IlLg, InHe, KaTp, MaGw, MaLe, MnFe, MnOg, MoHm, NcBr, NcTl, NhW, NhFs, NjGf, NjKs, NyJs NyTw, OhRn, OhWm, PaHg, PaVw, PaWr, VeFh, VeGe, VeP, VeSc, WaIr, WaJv, WaTh, WiWa
—var. aleuticum CaA, CaLe, MtFr, OrKf, WaTh
tenerum NjB
—'Scutum Roseum' CaLe, KaTp
—'Wrightii' CaA, CaFl, FlA, MeMg

AGLAOMORPHA

coronans CaCj, CaDb, CaFl, CaLe, KaTp, NjR

ALSOPHILA

australis CaA, CaAw, CaEm, CaFl, CaLe, CaLs, CaSn, CaWe, FlA, FlFa, FlBb, KaTp, NjR
excelsa CaAw

ASPIDIUM

capense CaA, CaAw, CaEm, CaLs, CaWe
[=*Rumohra adiantiformis*]

ASPLENIUM

auritum FlFa
bulbiferum CaAw, CaEm, CaFl, CaLe, CaLs, CaSn, CaWe, CnLo, FlFa, InYo, KaTp, MeMg, NjR
compressum FlFa
dentatum FlBb
nidus CaA, CaFl, CaLe, FlA, FlFa, FlBb, InYo,KaTp, MeMg, NjB, NjPs, NjR, ScGp
platyneuron CnRh, IlLg, InHe, MaAa, MaGw, MaLe, MoHm, NcBr, NcTl, NhFs, NhSk, NhW, NjGf, NyJs, NyTw, PaVw, PaWr, VeGe, VeP, VeSc, WiWa
ruta-muraria NyJs
serratum FlFa
trichomanes AlMj, InHe, MaAa, MaGw, MaLe, MoHm, NcBr, NcTl, NjGf, NhFs, NhW, NyJs, PaWr, VeFh, VeGe, VeP, WaIr
verecundum FlBb
viviparum CaFl, FlA, FlFa, KaTp, NjR

ATHYRIUM

alpestre var. americanum WaTh
filix-femina AlMj, CaHr, CaNw, CaSn, CnRh, CnWf, IlLg, InHe, KaTp, MaGw, MaLe, MdBm, MnFe, MnOg, MtFr, NcBr, NcTl, NhFs, NhSk, NhW, NjGf, NjKs, NyJs, NyTh, OhRn, OhSh, OhWm, PaHg, PaVw, VeFh, VeGe, VeP, VeSc, WaJr, WaTh, WiWa
—'Acrocladon' OrKf
—'Corymbiferum' OrKf
—'Cristulatum' OrKf
—'Frizelliae' OrKf
—'Gemmatum' OrKf
—'Plumosum' OrKf

ATHYRIUM (Cont'd.)

var. sitchense CaHr
—'Victoriae' OrKf
goeringianum CaDb, FlFa, OrKf, PaHg
—var. pictum OrKf, PaHg
pycnocarpon InHe, MaGw, NcTl, NhW, NyJs, NyTw, OhRn, VeFh, VeGe, VeSc
thelypterioides CnRh, CnWf, IlLg, MaGw, MaLe, NhFs, NhW, NjGf, NjKs, NyJs, NyTw, PaHg, PaWr, VeFh, VeGe, VeSc

BLECHNUM

brasiliense CaAw, CaFl, FlA, FlFa, KaTp
gibbum CaEm, CaFl, CaLe, CaLs, FlA, FlFa, KaTp
moorei CaEm, CaFl, CaLe, CaLs,
occidentale CaDb, CaLs
—var. CaDb
spicant CaA, CaNw, CaSn, WaIr WaTh

BOTRYCHIUM

dissectum f. dissectum NjGf
obliquum MnOg, NjGf, NyTw
virginianum CnRh, IlLg, InHe, MnOg, MoHm, NcBr, NhFs, NhSk, NjGf, NjKs, NyJs, NyTw, VeP

CAMPTOSORUS

rhizophyllus CnRh, InHe, MaAa, MaGw, MaLe, MoHm, NcBr NcTl, NhW, NjGf, NyJs, VeGe, VeMg, VeP

CAMPYLONEURON

angustifolium var. crenulatum FlFa

CERATOPTERIS

thalictroides FlFa

CHEILANTHES

densa CaHr, WaIr, WaTh
farnosa var. chrysophylla MiS
feei MtFr, SdPg
gracillima CaNw, MtFr, WaIr, WaTh
lanosa NyTw
tomentosa MoHm

CIBOTIUM

'Barometz Upright' CaFl
chamissoi CaA, CaAw, CaEm, CaFl, CaLs, CaSn, CaWe
schiedei MiS, NjR

CRYPTOGRAMMA

acrostichoides MtFr, WaIr, WaTh
crispa var. acrostichoides WaIr, WaTh

CTENITIS

pentangularis CaAw, CaFl, CaSn

CYATHEA

arborea NjR
cunninghamii MiS
dealbata MiS
fulva CaAw
medularis CaA, CaAw, CaFl, CaWe, KaTp, MiS

CYCLOPHORUS [PYRROSIA]

lingua CaSn, CnLo, FlFa, KaTp, MiS

CYRTOMIUM

falcatum CaA, CaAw, CaEm, CaFl, CaLs, CaSn, CaWe, CnLo, KaTp, NjB, NjPs, NjR
—'Rochefordianum' CaFl, FlFa,

CYRTOMIUM (Cont'd.)

MeMg, MiS, NjR, NjWm, ScGp
—'Rochefordianum Compactum'
FlA

CYSTOPTERIS

bulbifera CaA, CnRh, MaGw, MiS, MnOg, MoHm, NcBr, NhFs, NhW, NjKs, NyJs, NyTw, VeGe, VeP, VeSc, WiWa
fragilis CaHr, CnRh, MaGw, MoHm, MnOg, MtFr, NcTl, NhSk, NjGf, NyJs, NyTw, PaHg, PaWr, VeGe, VeP, VeSc, WaTh

DAVALLIA

bullata CaFl, FlFa, MiS
canariensis CaSn, CaWe, FlFa
denticulata FlFa
fijeensis CaFl, CaLe, FlFa, KaTp, NjR
—var. major CaAw, CaFl
—var. plumosa CaAw, CaFl, CnLo, FlFa, NjR, NjWm
griffithiana CnLo, MeMg, NjR, NjWm
mariesii CaAw, CaFl, CnLo KaTp, MeMg, NjR
pentaphylla FlFa, NjR, NjWm
solida CaSn, CnLo, FlFa, NjR, NjWm
tenuifolia CnLo
trichomanoides CaAw, CaEm, CaFl, CaLe, CaLs, CaSn, NjR

DENNSTAEDTIA

punctilobula CaHr, IlLg, InHe, KaTp, MaGw, MaLe, MiS, MnOg, NcBr, NcTl, NhFs, NhSk, NhW, NjGf, NjKs, NyJs, NyTw, OhWm, PaHg, PaVw, PaWr, VeFh, VeGe, VeP, VeSc

DICKSONIA

antarctica CaA, CaAw, CaEm, CaFl, CaLe, CaLs, CaSn, CaWe, FlFa, KaTp
fibrosa CaA, MiS, NjR

DIPLAZIUM

bantamense MiS
esculentum FlBb, FlFa

DOODIA

aspera KaTp

DORYOPTERIS

concolor CaLe, FlFa

DRYNARIA

heraclea FlFa
meyeniana FlFa
rigidula CaAw

DRYOPTERIS

arguta CaHr, WaJv
X boottii MaGw, NyJs, VeGe, VeSc,
clintoniana CnRh, NhFs, NyJs, VeGe, VeSc
cristata CaAw, CaLs, CnRh, IlLg, MaGw, MaLe, MnOg, NhFs, NhJs, NhSk, NhW, NjGp, NjKs, NyTw, VeFh, VeGe, VeSc, WiWa
dentata CaFl
dilatata CaHr, CaNw, MaGw, MiS, MtFr, NyJs, VeGe, VeSc, WaTh
—'Grandiceps' OrKf
—'Lepidota' OrKf
erythrosora CaA, CaAw, CaDb, CaEm, CaFl, CaLe, CaLs CaSn, FlA

DRYOPTERIS (Cont'd.)

filix-mas AlMj, CaFl, CaNw, CaSn, InHe, MaGw, MaLe, MiS, MtFr, NcBr, NcTl, NyJs, PaHg, Vege, VeP, WaTh, WiWa
—'Crispum Cristata' CaFl, CaLe, OrKf, WaIr
—'Cristata Martindale' OrKf
—'Linearis Polydactala' CaFl, OrKf
—'Ramosum' OrKf
goldiana AlMj, CoIg, InHe, MaGw, MaLe, MiS, NcBr, NcTl, NhFs, NyJs, NyTw, PaHg, VeGe, VeP, VeSc, WiWa
hirtipes CaDb
intermedia CaNw, MaGw, MnOg, NyTw, PaHg, VeP, VeSc
marginalis AlMj, CnRh, CnWf, InHe, MaGw, MaLe, MiSk, MoHm, NcBr, NcTl, NhFs, NhSk, NhW, NjGf, NjKs, NyJs, NyTw, PaHg, PaVw, PaWr, TxNh, VeFh, VeGe, VeP, VeSc, WiWa
nevadensis CaHr
pseudomas 'Acutum' OrKf
—'Angustata Cristata' OrKf
—'Barnsi' OrKf
—'Crispa' OrKf
—'Crispa Cristata' OrKf
—'Cristata' OrKf
—'Decomposita Cristata' OrKf
—'Divisolobum Laxum' OrKf
—'Grandiceps' OrKf
—'Lobatum' OrKf
—'Lux Lunea' OrKf
—'Polydactala Wills' OrKf
setigera CaFl
spinulosa AlMj, CnRh, CnWf, IlLg, InHe, MaGw, MoHm, NcBr, NcTl, NhFs, NhSk, NhW, NjGf, NyJs, NyTw, OhWm, PaHg, PaWr, TxNh, VeFh, VeGe, WiWa

GYMNOCARPIUM

dryopteris CnRh, IlLg, InHe, MaGw, MaLe, MiS, MnOg, MtFr, NhFs, NhW, NjKs, NyJs, VeGe, VeP, VeSc, WaTh, WiWa

HEMIONITIS

palmata FlFa

HUMATA

tyermannii CaA, CaAw, CaFl CaSn

LITOBROCHIA

tripartita FlFa

LOMARIA [=BLECHNUM]

gibba CaA, CaAw, FlBb
moorei CaA, CaAw

LYCOPODIUM

annotinum MnOg
clavatum MiS, MnOg, NjCf
complanatum PaVw, MaAa
flabelliforme NjGf
lucidulum MnOg, NjGf, PaVw
obscurum MnOg, NjGf, PaVw
—f. dendroideum NjGf
tristachyum NjGf

LYGODIUM

japonicum CaAw, CaEm, CaLs, FlFa
palmatum AlMj, InHe, MaGw, MiS, NcBr, NcTl, NyJs, NyTw, TxNh, VeP
scandens CaSn, KaTp, MiS, NjR
squarrosum MiS

MATTEUCCIA

pennsylvanica AlMj, CaHr, CnRh, CnWf, CoIg, IlLg, InHe, KaTp, MaGw, MaLe, MiBu, MiS, MnFe, MnOg, NcBr, NcTl, NhFs, NhW, NjGf, NjKs, NyJs, NyTw, OhRn, OhSh, OhWm, PaHg, PaVw, VeFh, VeGe, VeP, VeSc, WiWa

MICROLEPIA

firma CaAw, CaDb
platyphylla CaA, CaAw, CaLe, CaLs, CaWe
speluncae CaA, CaWe, FlFa, KaTp, MiS
strigosa CaAw, CaEm, CaFl, CaLe, CaLs, CaSn, KaTp

MICROSORIUM

diversifolium CaFl, MiS
scolopendria FlFa

MOHRIA

caffrorum FlFa

NEPHROLEPIS

biserrata var. furcans CaAw, CaLe, FlFa, KaTp
cordifolia FlFa, MiS
—'Plumosa' CaLe, CnLo, MiS, NjR, ScGp
duffii CnLo, FlFa, KaTp, NjB
exaltata CaA, CaAw, CaEm, CaFl, CaLs, CaSn, CaWe, KaTp, MeMg, MiS
—var. bostoniensis CaA, CaFl, CnLo, IlAf, MeMg, ScGp
—'Bostoniensis Compacta' NjR
—var. bostoniensis 'M. D. Mills' CaFl
—var. bostoniensis 'Splendida' CaFl, InYo
—'Childsii' CaFl, NjR
—var. elegantissima CaFl, CnLo
—'Fluffy Ruffles' CnLo, FlA, InYo, MeMg
—'Maassii' FlFa
—'Norwoodii' CaFl, InYo, KaTp
—'Piersonii' FlFa
—'Rooseveltii Plumosa' CaFl, FlFa
—'Selecta' FlFa
—'Smithii' CaLe, InYo, KaTp,
—'Verona' CaLe, CnLo, FlFa, MeMg, NjWm
—'Whitmanii' CaFl, CaLe, CnLo, FlA, FlFa, IlAf, InYo, KaTp, NjR

ONOCLEA

sensibilis CaHr, CnRh, IlLg, InHe, KaTp, MaGw, MaLe, MiS, MnFe, MnOg, NcBr, NcTl, NhFs, NhSk, NhW, NjGf, NjKs, NyJs, NyTw, OhRn, OhWm, PaHg, PaVw, PaWr, VeFh, VeGe, VeSc

ONYCHIUM

auratum MiS
densum MtFr [=*Cheilanthes*]
japonicum CaA, CaAw, CaSn, CaWe, MeMg

OSMUNDA

cinnamomea AlMj, CnRh, CnWf, IlLg, InHe, KaTp, MaGw, MaLe, MdBm, MiBu, MiS, MnFe, MnOg, NcBr, NcTl, NhFs, NhSk, NhW, NjGf, NjKs,NyJs, NyTw, OhRn, OhWm, PaHg, PaVw, VeGe, VeP, WaJv, WiWa

OSMUNDA (Cont'd.)

claytoniana AlMi, CaHr, CnRh, CoIg, IlLg, InHe, KaTp, MaGw, MaLe, MiS, MnFe, MnOg, NcBr, NcTl, NhFs, NhSk, NhW, NjGf, NjKs, NyJs, NyTw, OhWm, PaVw, PaWr, VeFh, VeGe, VeP, VeSc, WiWa
regalis AlMj, CnRh, CnWf, IlLg, InHe, MaGw, MaLe, MiBu, MiS, NcBr, NcTl, NhFs, NhSk, NhW, NjGf, NyJs, NyTw, PaHg, PaVw, VeFh, VeGe, VeP, VeSc, WiWa
—'cristata' OrKf

PELLAEA

adiantoides CaA, CaAw, CaFl, CaLs, CaNw, MeMg, NjR
andromedifolia CaA, CaNw
atropurpurea CnRh, MaAa, MaGw, MaLe, MoHm, NcBr, NcTl, NjGf, NyJs, SdPg, VeGe, VeSc
falcata CaA, CaAw, CaEm, CaFl, CaLs, CaSn, CaWe
hastata CaAw, CaFl
mucronata CaNw
rotundifolia CaA, CaAw, CaEm, CaFl, CaLs, CaSn, CnLo, FlA, KaTp, NjB, NjR
viridis CaA, CaEm, CaLe, CaLs, CaSn

PHEGOPTERIS

connectilis CaHr, CnRh, MaAa, MaGw, MaLe, MiS, MnOg, MoHm, NhFs, NhW, NjKs, NyJs, NyTw, VeGe, VeP, VeSc, WaIr
hexagonoptera CaHr, CnRh, InHe, MaGw, MaLe, MdBm, MiS, MoHm, NcBr, NhFs, NjGf, NjKs, NyKs, NyJs, NyTw, PaVw, PaWr, VeFh, VeGe, VeSc

PHYLLITIS

scolopendrium CaA, CaDb, CaFl, CaSn, CaWe, CnLo, MaGw, MiS, NjR
—'Crispum' OrKf
—var. cristatum CaA, NjR, OrKf
—'Marginatum' OrKf
—'Ramo-Cristatum' OrKf

PHYMATODES

nigrescens FlFa

PITYROGRAMMA

calomelanos MiS
chrysophylla FlFa
X hybrida CaAw, CaEm, CaLs, FlA
tartarea FlFa
triangularis CaA, CaNw

PLATYCERIUM

aethiopicum CaAw, NjR
alcicorne CaA, CaAw, CaWe, CnLo, KaTp, NjB
—var. majus FlFa
—'Wilhelmina Reginae' FlFa
andinum CaCj, FlFa
angolense CaCj, FlFa
bifurcatum CaCj, CaDb, CaLe, CaSn, FlBb, FlFa, MeMg, NjB, NjR
bloomii FlFa, NjR
coronarium FlFa, NjR
diversifolium FlFa
ellisii CaCj
grande CaA, CaCj, CaEm, CaLe, CaSn, CaWo, FlFa, KaTp, NjR
hillii CaCj, CaLe, FlFa, NjR
lemoinei FlFa, NjR

PLATYCERIUM (Cont'd.)

pumilum FlFa
stemaria CaCj, FlFa
sumbawense CaCj, FlFa
vassei CaCj, FlFa
veitchii CaCj, FlFa
willinckii CaCj, FlFa
'Cass Hybrids' CaDb

POLYPODIUM

aureum CaA, CaAw, CaDb, CaEm, CaFl, CaLs, FlFa
—var. cristatum CaFl
—var. glaucum CaA, CaDb KaTp, MeMg, NjB, NjPs
—var. mandaianum CaA, CaEm, CaLe, CnLo, NjWm, FlFa, KaTp, MiS, NjR
—var. mayi CaFl, CaLe
californicum CaHr
—'Sarah Lyman' CaHr
diversifolium CaDb
glauco-pruinatum CaA, CaAw
glycyrrhiza CaHr
heracleum CaCj, CaFl, CaSn
lepidopteris CnLo
meyenianum CaLe, KaTp, NjR
musifolium FlFa
normale CaDb, CaFl
piloselloides CnLo
plumula FlBb
polycarpon CaAw, CaFl, FlA, NjR
—var. grandiceps CaFl, FlA, FlBb, FlFa, KaTp, NjR, NjWm
polypodioides AlMj, FlFa, NcTl
scouleri CaHr
sporadocarpum CaFl
subauriculatum CaAw, CaDb, CaFl, CaLe, CaSn, CnLo, FlFa, KaTp, MiS
—'Knightii' CaFl, CaLe, FlA, FlFa, KaTp
vacciniifolium CnLo
virginianum AlMj, CaFl, CaNw, CaSn, CnRh, IlLg, InHe, MaAa, MaGw, MaLe, MiS, MnFe, NcBr, NcTl, NhFs, NhSk, NhW, NjGf, NjKs, NyJs, NyTw, PaVw, TxNh, VeFh, VeGe, VeP, VeSc, WaIr, WaTh
—var. hesperium CaHr, MtFr
'Howland Island Blue' CaAw
vulgare 'Cambricum' OrKf
—'Pulcherimum' OrKf

POLYSTICHUM

acrostichoides AlMj, CnLo, CnRh, CnWf, IlLg, InHe, KaTp, MaAa, MaGw, MaLe, MdBm, MiBu, MiS, MnFe, MoHm, NcBr, NcTl, NhFs, NhSk, NhW, NjGf, NjKs, NyJs, NyTw, OhRn, OhSh, OhWm, PaHg, PaVw, PaWr, TxNh, VeFh, VeGe, VeP, VeSc, WiWa
aculeatum CaFl, CaSn, CnLo KaTp, MeMg
—var. proliferum CnLo
adiantiforme CaFl, CaSn, FlA, KaTp, MeMg [=*Rumohra*]
andersonii OrKf, WaTh
angulare CaA, CaSn, CaWe
aristatum var. variegatum CnLo
braunii MaGw, MaLe, NyJs, VeGe, VeSc
dudleyi CaSn
lemmonii WaTh
lonchitis MaLe, MtFr, VeSc, WaTh
munitum CaA, CaDb, CaHr, CaNw, CaSn, MtFr, WaJv, WaTh
—var. imbricans CaHr
richardii MiS
scopulinum WaTh
setiferum CaSn

POLYSTICHUM (Cont'd.)

setosum CaA, CaAw, CaEm, CaLe, CaLs, CaSn, CaWe, FlA, KaTp
tsus-simense CaA, CaFl, FlA, FlFa, KaTp, MeMg, NjB, NjR

PSILOTUM

nudum FlBb

PTERIDIUM

aquilinum CaSn, IlLg, InHe, MaGw, MaLe, MiS, MnOg, MoHm, NcBr, NcTl, NhSk, NhW, NjGf, NyTw, PaHg, PaVw, WiWa
—var. lanuginosum MtFr

PTERIS

adiantoides NjB
argyraea CaA, CaAw, CaEm, CaLe, CaLs, CaWe, KaTp
cretica CaFl
—var. albolineata CaAw, CaLe, MiS, NjB, NjR, ScGp
—var. cristata MiS
—var. rivertoniana CaA, MiS, NjR
—var. wilsonii CaA, MeMg, NjR
—var. wimsettii CaA, KaTp, MiS, NjR
dentata CaAw, CaEm, CaLe, FlA
ensiformis MiS
—var. victoriae CaA, FlA, FlBb, IlAf, KaTp, MeMg, NjB, NjPs, NjR
flabellata CaA, CaAw, CaEm, CaFl, CaSn, NjR
flaccida CaA, CaWe
longifolia CaA, CaWe, KaTp, MiS
major CaFl
oenata CaLs
ouvrardii CaA, CaAw, CaEm, CaLs, CaSn, CaWe
parkeri CaA, MiS
—var. argyraea MiS
quadriaurita MiS
—var. argyraea CaFl, NjR
roweri MiS
semipinnata NjR
serrulata 'Cristata Nana Compacta' MiS
tremula CaA, CaAw, CaEm, CaFl, CaLe, CaLs, CaSn, CaWe, FlA, FlBb, KaTp, MiS, NjR
tripartita FlBb
umbrosa MiS
vittata CaAw, CaEm, CaLs

PYRROSIA

lingua CaDb, CaFl

RUMOHRA

adiantiformis CaDb

SADLERIA

cyatheoides CaA, CaAw, CaLs, CaSn

SELAGINELLA

emmeliana FlA, KaTp, NjR
kraussiana FlA, KaTp, MeMg, NjR
—var. brownii CnLo, KaTp, MeMg, NjR
martensii var. variegata CnLo, MeMg
serpens MiS
uncinata CnLo, NjR
willdenovii CnLo, FlHw, NjR

SPHENOMERIS

clavata FlBb

STENOCHLAENA

palustris CaA, CaFl, CaLe, FlFa, KaTp, NjR

TECTARIA

cicutaria CaAw, CaFl, CaLe FlA, KaTp
heracleifolia FlBb
minima FlBb

THELYPTERIS

noveboracensis CaHr, CnRh, MaGw, MdBm, NhFs, NhSk, NhW, NjGf, NjKs, NyJs, NyTw, PaHg, PaVw, PaWr, VeGe, VeSc
palustris CnRh, IlLg, InHe, MaGw, MiS, MnOg, NcBr, NcTl, NhFs, NhSk, NhW, NjGf, NjKs, NyJs, NyTw, VeGe
sclerophylla FlBb
setigera CaAw
simulata MaGw

VITTARIA

lineata FlFa

WOODSIA

ilvensis CnRh, MaAa, MaGw, MaLe, NhFs, NjKs, NyJs, VeFh, VeGe, VeP, VeSc, WiWa
obtusa CnRh, IlLg, MaGw, NjGf, NyJs, PaHg, VeFh, VeGe, VeSc
oregana WaTh
scopulina MtFr, SdPg

WOODWARDIA

areolata MaGw
chamissoi CaA, CaAw, CaDb, CaEm, CaLs, CaNw, CaSn
orientalis CaAw, CaDb, CaEm, CaLe, CaSn, FlA, KaTp
radicans CaA, CaAw, CaDb, CaLs, CaNw, CaWe
virginica CaWe, IlLg, MaGw, MiS, NcBr, NhFs, NhW, NjKs, NyJs, NyTw, VeGe, VeSc

LONGWOOD GARDENS, KENNETT SQUARE, PENN.

[Publication of the above list is an experimental venture. The author of the article, and the Editor of the FERN JOURNAL, will appreciate reports from members of the Fern Society about their success in obtaining good fern material through these sources. Printing this kind of list is expensive, so frequent revisions are not planned. The Secretary will have some reprints if needed.

Mrs. Kathryn Boydston, Custodian of the Spore Exchange for a number of years, requested that she be relieved of that responsibility. The Council accepted her resignation with regret, and with thanks for her loyal services, and in July appointed Mr. Neill D. Hall, 1225 NE 95th St., Seattle 15, Wash., as Custodian. Requests for spores should be sent to Mr. Hall.—I. L. W.]

A New Polypodium from Ecuador

WILLIAM R. MAXON

This new *Polypodium* was discovered in a fine South American collection sent in by Mrs. Ynes Mexía for identification.

POLYPODIUM **basale** Maxon, sp. nov.

Rhizoma erectum, 5–10 mm. longum, ca. 5 mm. diam., apice dense paleaceum, paleis confertis, ferrugineis, lanceolato-ligulatis, ca. 2 mm. longis, prope basim rotundam 0.3–0.5 mm. latis, apice attenuatis, tenuiter longe-ciliatis, ciliis paucis, ferrugineis, ca. 0.13 mm. longis; folia 3–5, cespitosa, 9–15 cm. longa; stipites 5–10 mm. longi, ca. 0.3 mm. diam., tenuiter castaneo-setosi, pilis fragilibus, ca. 1 mm. longis; laminae ligulatae, 8–14 cm. longae, 6–9 mm. latae, basim versus subabrupte angustatae, ad infimum anguste alatae, apice attenuatae, profunde pinnatifidae, ubique tenuiter castaneo-setosae, pilis patentibus, ca. 1 mm. longis, rhachi castanea tenui sursum immersa; segmenta 35–50 juga, patentia, oblonga, 3.5–4.5 mm. longa, ca. 2 mm. lata (basi leviter dilatata excepta), latere utroque ala ca. 0.5 mm. lata conjuncta, integra, tenere herbacea, subtus hinc inde pilis glandulosis albidis furcatis minutis praedita; venae simplices, mediae, immersae; sori solitarii, rotundi, 1.5 mm. diam., rhachi contigui, venae basi decurva siti; sporangia annulo articulis ca. 14 formato cincta, sporis triplanatis papillosis, ca. 35 μ diam.

Type in the U. S. National Herbarium, no. 1,691,351, collected near Puyo, Province of Napo-Pastaza, Ecuador, alttiude 400 meters, on trunks in dense forest, February 18, 1935, by Mrs. Ynes Mexía (no. 6930).

[The above description was written by the late Dr. William R. Maxon. It is only one of a number of novelties that he never got around to publishing. The species belongs to the group known as *Xiphopteris*, but it is not referable to any of the species treated by E. B. Copeland in his paper "The American Species of Xiphopteris."[1] In Dr. Copeland's key it would run to *X. cookii* Maxon, but that is surely different by its non-ciliate rhizome scales. The alliance is probably with *Polypodium taenifolium* Jenman, which differs primarily in having the vein of the segment forked, a character with perhaps not quite the importance assigned to it by Maxon and Copeland. In this species the vein is simple, but the position of the sorus on the distal side of the vein at its base indicates an incipient branch. The generic distinctness of *Xiphopteris* is debatable.—C. V. Morton.]

SMITHSONIAN INSTITUTION, WASHINGTON, D. C.

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[1] THIS JOURNAL **42**: 41–52, 93–110. 1952.

Botrychium matricariifolium A. Br., New to the Flora of Delaware, with Additional Records from Maryland and West Virginia

CLYDE F. REED

One of the most elusive ferns in our region is *Botrychium matricariifolium*[1] A. Br. Clausen (1938) did not mention in his records nor indicate on map 16 any localities for this fern in either Delaware or West Virginia. Tatnall (1946) did not mention this species for any of the three states of the Delaware Peninsula. However, Reed (1956, 1960) found this species in Accomac County, Virginia, the most southern locality in coastal eastern United States. Brooks (1938) did not mention this fern in the fern flora of West Virginia. However, Strausbaugh and Core (1952) list this species from Preston, Hardy, and Grant Counties, West Virginia. Reed (1953, 1956) outlined the distribution of this species in Maryland.

In Delaware the author found about two dozen plants of *Botrychium matricariifolium* in a woods along a creek on Beaver Valley Road (which is east of Brandywine Creek and east of Granogue) in New Castle County. This area of New Castle County is on the Piedmont, south of Delaware County, Pennsylvania, where the species was recorded by Clausen (1938). The Delaware specimens were collected on June 22, 1961, *Reed* 50979. Seven specimens were collected and all were fruiting. Two of the plants are of interest as there are some sporangia on the otherwise sterile portion of the fronds. These specimens measured 11, 13, 14, 17, 19.5, 20 and 22 cm. in height.

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[1] The original spelling was "*matricariaefolium*" but this is not in accord with the rules in the International Code of Botanical Nomenclature. Recommendation 73G states that in compounds of Latin words, the final vowel of the first element in the compound is reduced to "*i*." (The example given is "*salviifolius*" from "*Salvia*" and "*folius*".) Article 73, Note 2, reads, "The use of a wrong connecting vowel . . . is treated as an orthographic error," and the main part of Article 73 reads, "The original spelling of a name or epithet must be retained, except that orthographic errors should be corrected." Therefore, the original spelling "*matricariaefolium*" should be corrected to "*matricariifolium*."

In West Virginia the author found about a dozen plants along the edge of a woods, four miles south of Cranesville Swamp, on the road to Terra Alta, Preston County. Four fruiting specimens were collected on June 16, 1961, *Reed* 50893, and measured 11, 12, 14, and 17.5 cm. in height.

In addition to the previously recorded specimens from Garrett County, Maryland (Reed, 1956), another fruiting specimen of this fern was found at the edge of a woods just west of Oakland. It was collected on June 16, 1961, *Reed* 51015, and measured 17.5 cm. in height. This record is near West Virginia and is in western Garrett County, whereas the other record is in the northeastern part of Garrett County near Finzel on Savage Mountain. All specimens cited are in the Reed Herbarium, in Baltimore.

Our present knowledge of the southern limit of distribution of *Botrychium matricariifolium* is as follows: TENNESSEE: along Huskey Gap Trail, Great Smoky Mountains National Park (O'Dell, 1961); VIRGINIA: Accomac County on the Delmarva Peninsula, in the Blue Ridge Mountain of Fauquier County (US 1871659) and in Rockingham and Page counties Anne Arundel and Prince Georges counties, and in the Allegheny Mountains of Preston, Grant, and Hardy counties; MARYLAND: on the Piedmont Plateau of Baltimore, Howard, Carroll, and Montgomery counties, on the Inner Coastal Plain in Anne Arundel and Prince Georges counties, and in the Allegheny Mountains in Garrett County; DELAWARE: on the Piedmont Plateau in New Castle County.

LITERATURE CITED

BROOKS, M. G. 1938. The Pteridophytes of West Virginia. W. Va. Univ. Bull. ser. **39**, no. **2**: 1–60.

CLAUSEN, R. T. 1938. A Monograph of the Ophioglossaceae. Mem. Torrey Club **19**: 1–177.

MASSEY, A. B. 1960. The Ferns and Fern-Allies of Virginia. 3rd ed. Bull. 256, Virginia Polytechnic Institute Agr. Ext. Service, Blacksburg, Va.

O'DELL, H. 1961. An Addition to the List of Ferns Found Growing Naturally in Tennessee. Amer. Fern Jour. **51**: 156.

REED, C. F. 1953. The Ferns and Fern-Allies of Maryland and Delaware, Including the District of Columbia. Reed Herbarium, Baltimore, Md.

———. 1956. New County Records for *Botrychium matricariaefolium* in Maryland and Delmarva. Amer. Fern Jour. **46:** 148–151.

———. 1960. The Ferns and "Fern-Allies" of Accomac and Northampton Counties, Virginia and Adjacent Maryland. Castanea **25:** 109–116.

STRASBAUGH, P. D. and E. L. CORE. 1952. Flora of West Virginia. I. W. Va. Univ. Bull. ser. **52**, no. **12-2:** 1–273.

TATNALL, R. R. 1946. Flora of Delaware and the Eastern Shore. Society of Natural History of Delaware.

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Cytotaxonomy of the Isoetes echinospora Complex[1]

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INTRODUCTION

The quillworts, or the genus *Isoëtes*, are among those fern-allies that are in great need of cytotaxonomical and experimental revision. Though Linnaeus (1753) recognized only a single species, later authors have generously described new species of this group even from very limited collections, with the result that Reed (1953) recognized over 610 names, representing, in the view of Lawrence (1951), only about 60 species. It is evident from the studies by Iversen (1928a,b) that several of the characters used for the separation of many of these taxa are taxonomically doubtful, and there is reason to believe that a few are only occasional edaphic modifications. Some are evidently good races which ought to be treated at the varietal or subspecific level, whereas still others are undoubtedly very good species.

Distinguishing four sections on the basis of surface characters of the megaspores, as proposed by Pfeiffer (1922), may be apparent rather than natural, but the morphological characters used in separating the monotypic genus *Stylites* (Amstutz, 1957) seem to be genuine. Though the distinction and relationship of Isoëtaceae to other ferns and fern-allies have been widely dis-

[1] Research supported by the National Research Council of Canada and by grant No. 69 of the NATO Science Grants Programme.

cussed, the morphological method has been inadequate to decide if the family ought to be grouped as a class of its own (Lawrence, 1951), as a subclass of the Lycopsida (Pichi-Sermolli, 1959), or as an order between the Lycopsids and the eusporangiate ferns (Reed, 1953). The latter question is not likely to be solved by aid of biosystematic methods other than those utilizing biochemical approaches (cf. Bate-Smith, 1959), whereas cytological and experimental comparisons may contribute to the solution of the problems at a lower level.

Chromosome numbers from the diploid to the decaploid level are known from the genus *Isoëtes,* and distinct variations in length of the chromosomes and in the position of their centromeres perhaps may make it possible to recognize karyotypes and compare them from one taxon to another. The present study is an attempt to utilize some of these characters for the understanding of a disputed complex of such taxa, though it is perhaps most evident in this case that such methods are sometimes of a limited value as an additional indication of status, whereas they cannot and should not replace the classical morphological and geographical methods of approach.

OBSERVATIONS

ISOETES ECHINOSPORA Dur. *sensu stricto*

This species in its strict sense was described from Gironde in central France by Durieu (1861). It is a small plant with 10–30 submerged leaves, which vary in length between 5 and 50 cm. depending on locality and climate, soft and recurved. Stomata are usually absent on the leaves (cf. Iversen, 1928a). The sporangia are pale and unspotted, the velum is very narrow. The megaspores are 400–600 microns, densely echinate, with fine truncate spines, whereas the microspores are 20–35 microns in diameter. The taxon is distributed in boreal Eurasia but it is also met with in central Siberia (cf. Hultén, 1958). Its chromosome number was reported to be $2n = 22$ by Ekstrand (1920); this was confirmed by Ehrenberg (1945) though most of his plants seem to have had $2n =$ c. 100 chromosomes; this higher

number was also reported in a sample from Ireland by Manton (1950). It is possible that these latter numbers have been counted on hybrid populations or on specimens of *I. lacustris*, since the present writer found only $2n = 22$ chromosomes in plants from some localities in southern Sweden.

ISOETES MURICATA Dur.

A variable eastern North American species that was described by Durieu (1864) from live specimens sent from Woburn in Massachusetts and cultivated in the Botanical Garden at Bordeaux. In its typical form, var. *muricata*, it is a plant with rather long leaves, 10–15 cm. long, flaccid and commonly spirally twisted, slender and recurved. Stomata are present though not frequent on the leaves (Iversen, 1928a). The sporangia are pale and somewhat spotted, the velum covers ½ to ¾ of the sporangium. The megaspores are 200–700 microns, probably depending upon some environmental factors, covered with broad spinules that may be forked or toothed, whereas the microspores are 20–35 microns in diameter.

The variety *Braunii*, described by Durieu (1864) as a species from Lake Winnipesaukee in New Hampshire, is usually somewhat smaller, with leaves ranging in length between 5 and 30 cm. and there are a few stomata mainly on the tips of the leaves. The megaspores vary between 250 and 600 microns depending upon climate and locality: the smallest spores have been measured on plants from the deeper and colder parts of some Icelandic lakes, whereas in shallow and more warm parts of the same lakes the spores are invariably larger. The western extreme of var. *Braunii* is *I. echinospora* var. *truncata* A. A. Eaton (in Gilbert, 1901), whereas var. *Savilei* Boivin (1961) is either a forma, or, more likely, an arctic modification comparable to the plants from the deeper parts of cold Icelandic lakes mentioned above. The microspores of var. *Braunii* are 20–35 microns in diameter.

The variety *hesperia* was described by Reed (1945) from Bear Creek in Idaho, at the altitude of 2,250 meters. It is distinctly

smaller than typical and even arctic var. *Braunii*, with 10–20 leaves that are only about 5–15 cm. long. The sporangia are pale-spotted but the velum is narrow, covering about ¼ of the sporangium. The megaspores on specimens seen by the writer are 400–600 microns with long and fine spines, whereas the microspores are 25–35 microns in diameter.

As shown by Reed (1945), the typical var. *muricata* is distinctly an eastern American boreal plant. The var. *Braunii* is a transcontinental, and in the east somewhat more northern plant reaching to western Greenland and Iceland (Hultén, 1958; Löve & Löve, 1961a), whereas the var. *hesperia* is a plant of the western American mountains.

The chromosome number of eastern North American plants of var. *muricata* was reported as $2n = 24$–26 by Dunlop (1949), but Löve & Löve (1961a) found $2n = 22$ only in Icelandic material of the var. *Braunii*. This same number has also been confirmed by the writer on Quebec material of var *muricata*, on material from New Hampshire and Manitoba of var. *Braunii*, and on plants from the southern Canadian Rocky Mountains belonging to var. *hesperia*.

ISOETES MARITIMA Underw.

This is a plant with a few leaves, only 5–20, which are 2–5 cm. long, slender but rather rigid with fine-pointed tips; the stomata on the leaves are always numerous and scattered all over the surface. The sporangia are pale-spotted, the velum is narrow and covers ¼ to ½ of the sporangium. The megaspores are 350–600 microns, with rather thick and blunt spines, white; microspores are usually 30–40 microns in diameter.

This species was described by Underwood (1888) from a salt marsh near Alberni on Vancouver Island in British Columbia. It is distributed near the coast of the State of Washington, British Columbia, and Alaska to the Aleutian Islands and Commander Islands (Hultén, 1948) and seems to prefer somewhat saline localities. In the southernmost part of this area the taxon is represented by a variety *Flettii* (A. A. Eaton) Reed, which differs mainly in the width of the velum that covers ½ to ⅔ of

the sporangium. It is often so vaguely distinct from the main type that the writer hesitates to regard it as anything more than a southern ecotype.

Material from a salt marsh in western British Columbia near Vancouver, belonging to the typical race, was found to have $2n = 22$ chromosomes.

ISOETES ASIATICA (Makino) Makino

An eastern Asiatic plant distributed from Honshu to Sakhalin and the Kurile Islands and also met with in Kamtchatka (Hultén, 1958) and, according to Boivin (1961) reaching Alaska. It was described by Makino (1904) as a variety of *I. echinospora*, but later Makino (1914) lifted it to specific rank. The type locality is at Lake Nojiri in the mountains of the province Shinano in central Honshu, but the plant seems to be rare in the Japanese mountains. It differs from *I. echinospora sensu stricto*, in having a broader velum that covers ⅔ to ¾ of the sporangium, and also in having coarser spinules on the macrospores and smoother microspores. There are usually only 5–30 leaves, 3–15 cm. long and rather rigid, without stomata. The chromosome number of this taxon is $2n = 22$, according to Takamine (1921).

CHROMOSOME MORPHOLOGY

The fixations used for this study were not made specially with studies on the morphology of the chromosomes in mind. However, the chromosomes of all the taxa mentioned above are rather long though distinctly variable in size within each chromosome complement. Their centromeres are usually median or submedian, but sometimes subterminal, and by aid of the centromere position and studies of the variations in length it is possible to recognize some of the chromosome pairs with reasonable certainty even when fixed with chromosome number determinations alone in mind. Comparisons of the chromosome complements of the taxa available to the writer seemed to indicate that possible differences in chromosome size and morphology between these taxa are not greater than variations met within each taxon, so it seems reasonably safe to conclude that these taxa at least

do not show any distinct differences in the morphology of their chromosomes; and the chromosome number $2n = 22$ is characteristic of them all.

TAXONOMICAL CONCLUSIONS

It has been concluded recently by Hultén (1958) that the main taxa here studied should be treated as varieties, or at most as subspecies, of a single circumpolar species. This is supported by the spore morphology of all the taxa and, also, by the stomatal characters studied by Iversen (1928a). Since the cytological observations seem to support the view that these taxa are only vaguely dissimilar though geographically and ecologically somewhat distinct, the writer agrees that they are conspecific races. Because the four main taxa constitute morphologically somewhat distinct regional groups of populations, they are logically treated at the subspecific level, whereas their somewhat more local minor races are distinguished as varieties only (Löve & Löve, 1961b). This has been proposed recently for the populations of the western Atlantic region by Löve & Löve (1961a) and, independently, by Boivin (1961).

Although the name of the European species, *I. echinospora* Dur., which is traditionally very well established, seems to be the oldest valid epithet within this group, it has been pointed out by Rothmaler (1944) that it is antedated by two other names. The oldest one is that of *I. setacea* described by Lamarck (1789), but since that name has not been used in this sense but rather in the sense of Delile (1827), Rothmaler (1944) proposed that it be rejected as a "nomen confusum"; in this the present writer agrees. The second valid name, according to Rothmaler (1944), should be *I. tenella* Leman (in Desvaux, 1827), which was based on the variety *tenella* of *I. lacustris* described by Leman (1822); the holotype of this name is the Tab. 191 in Flora danica (Oeder, 1766).

The description by Leman (1822) is short: "Une troisième variété, l'*isoëtes tenella*, croî en Danemarck: elle offre un très petit tubercule, d'oú partent six ou huit frondes sétacées, molles,

longues de trois pouces environ. Elle est figurée, planche 191 de la Flore danoise."

Since the description is inconclusive for a distinction between *I. lacustris* and *I. echinospora*, only the picture is left for the identification of the new spcies. Although Rothmaler (1944) did not hesitate to identify the picture with *I. echinospora*, Lange (1887)thinks it is *I. lacustris* and adds the remarks: "Nomine *Isoëtis lacustris* specimen delineatum est, ad Norderhoug Norvegiae lectum. Figura nimis imperfecta est ad dijudicandum, utrum *I. lacustris* L. vera, an *I. echinospora* D.R. pictori ante oculus fuit. Secundum Blytt (Norg. Fl. 3, p. 1238) utraque species hinc inde in Norvegia occurrit, locus autem in Fl. Dan. indicates inter stationes l.c. enumeratas non invenitur."

The present writer has seen the plate in question and agrees with Lange (1887) that it cannot be identified with any assurance with either *I. lacustris* or *I. echinospora*. Since not only Oeder (1766) himself but also Lange (1887) named it *I. lacustris*, the safest conclusion seems to be that this is correct, and the identification of this picture with *I. echinospora* as proposed by Rothmaler (1944) must be regarded as doubtful enough to be rejected.

The first certain name for a plant of the circumpolar group here treated is, thus, *I. setacea*, but since it is a "nomen confusum," the valid name is *I. echinospora* Dur. The typical subspecies of this taxon is, then, ssp. *echinospora*; the common North American plant is ssp. *muricata* (Dur.) Löve & Löve; the race in the salt marshes of the western coast of North America is ssp. *maritima* (Underw.) Löve, whereas the eastern Asiatic plant is to be named ssp. *asiatica* (Makino) Löve. The many formae listed by Reed (1953) on the authority of Gandoger (1891) and Iversen (1928a) can be dismissed, though the spore characters used by the latter certainly are important. The Asiatic and west-coast American races show small variations of little phytogeographical interest, whereas the more common North American race, ssp. *muricata*, includes at least three geographically somewhat distinct and ecologically remarkable varieties

of taxonomical interest, or var. *muricata*, var. *Braunii*, and var. *hesperia* (cf. Reed, 1945). A review of these taxa and their essential synonyms is given below.

ISOETES ECHINOSPORA Dur.

I. setacea Lamarck, 1789, non Bosc ex Delile 1827, nomen confusum.
I. tenella, sensu Rothmaler, 1944, non Leman, 1822.
I. echinospora Durieu, Bull. Soc. Bot. Fr. **8:** 164. 1861.
Calamaria echniospora Kuntze, Rev. Gen. Pl. **2:** 828.

ssp. ECHINOSPORA

I. echinospora s.str. auct. Eur. bor. et occid.

LOCUS CLASSICUS: Gironde, France.

GEOGRAPHICAL AREA: Northern and western Europe, from northern Spain to northern Norway, from Ural west to Ireland and the Faeroes; central Siberia, not in Iceland.

spp. MURICATA (Dur.) Löve & Löve

I muricata Durieu, Bull. Soc. Bot. Fr. **11:** 100. 1864.
I. echinospora ssp. *muricata* (Dur.) Löve & Löve, Bot. Notiser **114:** 49. 1961a. Boivin, Amer. Fern Journ. **51:** 83. 1961.

var. MURICATA

I. muricata Durieu (1864), 100, *sensu stricto.*
I. echinospora var. *muricata* (Dur.) Engelmann, in Gray's Manual ed. 5, 676. 1867.
I. Boottii Engelmann, in Gray's Manual ed. 5, 676. 1867.
I. echinospora var. *robusta* Engelmann, Transact. St. Louis Acad. Sci. **4:** 380. 1882.
I. echinospora Braunii f. *muricata* (Dur.) Clute, Fern Bull. **16:** 55. 1908.

LOCUS CLASSICUS: Woburn, Massachusetts.

GEOGRAPHICAL AREA: Eastern North America, from Novia Scotia south to New Jersey, west to Ohio and Michigan.

var. BRAUNII (Dur.) Löve & Löve

I. echinospora ssp. *muricata* var. *Braunii* (Dur.) Löve & Löve, Bot. Notiser **114:** 49. 1961a.
I. Braunii Durieu, Bull. Soc. Bot. Fr. **11:** 101. 1864, non Unger in Bruckman, 1850.
I. echinospora var. *Braunii* (Dur.) Engelmann in Gray's Manual ed. 5, 676. 1867.
I. echinospora ssp. *muricata* var. *Savilei* Boivin, Amer. Fern Journ. **51:** 85. 1961.

I. echinospora var. *Flettii* A. A. Eaton. Fern Bull. **13:** 51. 1905.

LOCUS CLASSICUS: Lake Winnipesaukee, New Hampshire.

GEOGRAPHICAL AREA: North America: Western Greenland and Newfoundland to Alberta and Yukon, south to Pennsylvania, Ohio, Minnesota, and Saskatchewan; Europe: Iceland.

var. **hesperia** (Reed) Löve, comb. nov.

I. muricata var. *hesperia* Reed, Amer. Fern Journ. **35:** 84. 1945.

LOCUS CLASSICUS: Bear Creek, Idaho.

GEOGRAPHICAL AREA: Alpine regions of western North America, from California, Idaho, Colorado, and Utah north to Alaska and Yukon.

spp. **maritima** (Underw.) Löve, comb. nov.

I. maritima Underwood, Bot. Gazette, **13:** 94. 1888.

I. Macounii A. A. Eaton, Fern Bull. **8:** 12. 1900.

I. echinospora var. *truncata* A. A. Eaton, in Gilbert, List North Amer. Pteridoph. 27. 1901.

I. echinospora var. *maritima* (Underw.) A. A. Eaton, Fern Bull. **13:** 52. 1905.

I. echinospora var. *Braunii* f. *maritima* (Underw.) Clute, Fern Bull. **16:** 55. 1908.

I. Braunii var. *maritima* (Underw.) Pfeiffer, Ann. Mo. Bot. Gard. **9:** 174. 1922.

I. beringensis Komarov, Bull. Jard. Bot. Acad. Sci. USSR **30:** 196. 1932.

LOCUS CLASSICUS: Alberni, Vancouver Island, British Columbia.

GEOGRAPHICAL AREA: Near the coast of western North America, from State of Washington, British Columbia and Alaska to the Aleutian Islands and Commander Islands.

ssp. **asiatica** (Makino) Löve, comb. nov.

I. echinospora var. *asiatica* Makino, Bot. Mag. Tokyo **18:** 129. 1904.

I. asiatica (Makino) Makino, Bot. Mag. Tokyo **28:** 184. 1914.

LOCUS CLASSICUS: Lake Nojiri, in the Shinano province, central Honshu.

GEOGRAPHICAL AREA: Japan, from Honshu to Hokkaido, in the mountains; Kurile Islands, Kamtchatka, Alaska (Boivin, 1961).

LITERATURE CITED

AMSTUTZ, E. 1957. *Stylites*, a new genus of Isoëtaceae. Ann. Mo. Bot. Gard. **44:** 121–123.

BATE-SMITH, E. C. 1959. Plant biochemistry. Vistas in botany: 100–123.

BOIVIN, B. 1961. *Isoëtes echinospora* Durieu in North America. Amer. Fern Journ. **51:** 83–85.

DELILE, A. R. 1827. Examen sur la végétation de *l'Isoëtes setacea*, et exposition de ses caractères. Mém. Museum, Paris, **14:** 100–119.

DESVAUX, A. N. 1827. Prodrome de la famille des Fougères. Mem. Soc. Linn. Paris, **6:** 171–212, 213–337.

DUNLOP, D. W. 1949. Notes on the cytology of some Lycopsids. Bull. Torrey Bot. Club **76:** 266–277.

DURIEU DE MAISONNEUVE, M. C. 1861. Echantillons de trois espèces d'*Isoëtes*. Bull. Soc. Bot. Fr. **8:** 164–165.

———. 1864. Notes sur quelques espèces nouvelles d'*Isoëtes* de l'Amérique du Nord et de l'Australie. Bull. Soc. Bot. Fr. **11:** 100–105.

EHRENBERG, L. 1945. Kromosomtalen hos några kärlväxter. Bot. Notiser **1945:** 430–437.

EKSTRAND, H. 1920. Über die Mikrosporenbildung von *Isoëtes echinospora* Dur. Svensk Bot. Tidskr. **14:** 312–318.

GANDOGER, M. 1891. Flora Europaea **27:** 193–196.

GILBERT, B. D. 1901. Working list of North American Pteridophytes north of Mexico, together with descriptions of a number of varieties not heretofore published. Utica. 40 pp.

HULTÉN, E. 1958. The amphi-atlantic plants and their phytogeographic connections. Sv. Vetensk. Akad. Handl. IV, 7, **1:** 1–340.

IVERSON, J. 1928. Über die Spezies Umgrenzung und Variation des *Isoëtes echinospora* Durieu. Bot. Tidsskr. **40:** 126–131.

———. 1928. Über *Isoëtes* in China und Japan. Dansk Bot. Arkiv. VII, **23:** 1–4.

LAMARCK, J. B. A. P. M. 1789. Encyclopédie méthodique. Botanique. III. Paris.

LANGE, J. 1887. Nomenclatur Florae Danicae. Hauniae.

LAWRENCE, G. H. M. 1951. Taxonomy of vascular plants. New York.

LEMAN, D. S. 1822. *Isoëtes*. Dict. sci nat. (Bot.). **24:** 22–24.

LINNAEUS, C. 1753. Species plantarum. Holmiae.

LÖVE, A. & LÖVE, D. 1961a. Some nomenclatural changes in the European flora. II. Subspecific categories. Bot. Notiser **114:** 48–56.

——— & ———. 1961b. Chromosome numbers of Central and Northwest European plant species. Opera Botanica **5:** I–VIII, 1–581.

MAKINO, T. 1904. Observations on the flora of Japan. Bot. Mag. Tokyo **18:** 129–131.

———. 1914. Observations on the flora of Japan. Bot. Mag. Tokyo **28:** 174–186.

MANTON, I. 1950. Problems of cytology and evolution in the Pteridophyta. Cambridge.

ØDER, G. C. 1766. Aftegninger paa de Planter, som voxe vildt i Kongerigerne Danmark og Norge, i Hertugdommene Slesvig og Holstein, og i Grevskaberne Oldenborg og Delmenhorst, til at oplyse det under Titel Flora Danica paa Kongelig Befaling foranstaltete Verk over disse Planter. Andet Bind. Kiöbenhavn.

PFEIFFER, N. E. 1922. Monograph of the Isoëtaceae. Ann. Mo. Bot. Gard. **9**: 79–232.

PICHI-SERMOLLI, R. E. G. 1959. Pteridophyta: Vistas in Botany. 421–493.

REED, C. F. 1945. Some nomenclatural changes in the genus *Isoëtes*. Amer. Fern Journ. **35**: 77–86.

———. 1953. Index Isoëtales. Bol. Soc. Brot. **27**: 5–72.

ROTHMALER, W. 1944. Pteridophyten-Studien. I. Fedde Repert. **54**: 55–82.

TAKAMINE, N. 1921. Some observations in the life-history of *Isoëtes*. Bot. Mag. Tokyo **35**: 184–190.

UNDERWOOD, L. M. 1888. The distribution of *Isoëtes*. Bot. Gazette **13**: 89–94.

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A Resume of the Taxonomic Reorganization of Equisetum, Subgenus Hippochaete, IV.

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HYBRIDS

In the previous papers of this series I have given a key to, and short descriptions and discussions of, the sections, subsections, species, subspecies, and varieties of *Hippochaete*. My taxonomic system may appear simpler than those of previous workers. Probably the single most important factor contributing to an understanding of the taxa and their relationships was the discovery of extensive hybridization in the subgenus. To find six hybrids between various pairs among seven species certainly is unexpected, particularly in an ancient group of plants presumed to be evolutionarily static.

The identification of these hybrids was based on three kinds of evidence: spore abortion, morphology, and geographic distribution. Specimens with aborted spores, together with those vegetative specimens closely resembling them, were segregated into a group and their measurable characters were analyzed sta-

tistically. These specimens were intermediate between the two species. When their collection localities were plotted on maps, it was seen that the specimens with aborted spores occurred in the regions of overlap of the species between which they were intermediate morphologically. The few exceptions, notably the high percentage of abortion in *E. variegatum* from northern regions and the occurrence of hybrid specimens outside the range of one parent, were explainable in other ways.

As their synonymies show, these hybrids previously have been recognized as varieties of one parent or as distinct species; in some cases, hybrid origins had been postulated previously.

E. hiemale var. *schleicheri* Milde, Verh. Zool.–Bot. Ges. Wien **11**: 345. 1861 (*pro sp.*).

E. giganteum × *myriochaetum.*

This hybrid has tall, evergreen stems bearing regular verticils of branches and having stomata in bands of 1 or 2 lines. The endodermis is individual, and the branch ridges bear irregular to sawtooth tubercles. Thus *E.* × *schaffneri* strongly resembles *E. giganteum*, but the fewer lines of stomata, the silica tubercles, and its aborted spores reveal its origin from the crossing of *E. giganteum* with *E. myriochaetum*. It has been collected in Mexico, Central America, Colombia, Venezuela, Ecuador, and Peru. Since *E. giganteum* hasn't been recorded from Mexico, and *E. myriochaetum* is unknown in Venezuela, this distribution may indicate that *E.* × *schaffneri* has some method of vegetative dispersal, or alternatively, it could be a relict of the greater range of the parents in past times.

II. EQUISETUM HYEMALE × MYRIOCHAETUM.

Tall, unbranched to sparsely or much branched, evergreen stems with stomata in single lines characterize this hybrid. The lower sheaths on the stem have dark girdles encircling their mid-region and are tan above. Silica tubercles on the branch ridges are irregular to serrate. Plants of this hybrid have been collected in Mexico from Nuevo Leon and San Luis Potosí, south to Guatemala. Most of the plants belonging here resemble coarse

stems of *E. myriochaetum*, but some are unbranched and look more like *E. hyemale* var. *affine* or *E.* × *ferrissii*.

Milde (1867, p. 505) described, under the name *E. mexicanum*, a plant that may be this hybrid, although without seeing the type I cannot be certain. This name is a later homonym of *E. mexicanum* Milde (Verh. Zool.-Bot. Ges. Wien **12**: 1256. 1862), which was based on a fragment of a stem that Milde later, doubtless incorrectly, decided was *E. ramosissimum*.

III. EQUISETUM × MOOREI Newm. Phytologist **5**: 19. 1854 (*pro sp.*).

E. hyemale var. *hyemale* × *ramosissimum* subsp. *ramosissimum*.

E. hiemale var. *schleicheri* Milde, Verh. Zool.–Bot. Ges. Wien **13**: 494. 1863.

E. hiemale var. *occidentale* Hy, Bull. Soc. Bot. France **37**: LXI. 1890.

Hippochaete × *samuelssonii* (W. Koch) Rothm. Repert. Sp. Nov. Fedde **54**: 81. 1944.

This hybrid has tall to medium, unbranched, smooth or slightly rough stems which are partially or completely deciduous. The stomata are in single lines. The sheaths are long-funnelform and the teeth usually absciss. *Equisetum* × *moorei* grows in Europe from northern Italy to Lithuania and Gotland Island, and from Ireland and England to Hungary, and it has been collected also north of the Caspian Sea, sometimes in regions where one parent appears to be absent. An increased drought in central Asia may have eliminated *E. hyemale* recently from that region. Perhaps some other factor has made *E. ramosissimum* rare or absent in northern Europe, or possibly the hybrid has been carried there by commerce, as *E.* × *ferrissii* has been carried to eastern North America.

Though usually mistaken for *E. hyemale*, *E.* × *moorei* can be identified readily by its smoothish stems with elongated sheaths and by its deciduous habit and aborted spores. There is such a close resemblance between *E.* × *moorei* and *E.* × *ferrissii* that

the most reliable way to distinguish them is by the continent of origin of the specimen.

Samuelsson first recognized the hybrid nature of *E.* × *moorei*, according to Schaffner (1931, p. 97), and Manton (1950) confirmed it with cytological evidence.

IV. EQUISETUM × FERRISSII Clute, Fern Bull. **12**: 22. 1904 (*pro sp.*).

E. hyemale var. *affine* × *laevigatum*.

E. laevigatum var. *elatum* Engelm. Amer. Jour. Sci. & Arts **46**: 87. 1844.

E. hiemale intermedium A. A. Eat. Fern. Bull. **10**: 120. 1902.

E. hiemale var. *suksdorfi* A. A. Eat. ibid **11**: 110. 1903.

E. laevigatum auct., non A. Br., e.g., Schaffner, Ohio Nat. **13**: 19–22. 1912, and most subsequent authors.

E. hyemale var. *elatum* Morton, Leafl. West. Bot. **6**: 156. 1951.

E. laevigatum subsp. *laevigatum* of Hartman, Trans. Kansas Acad. Sci. **61**: 125–148. 1958.

The tall to medium, smooth to rough, unbranched stems of this hybrid die back from the tip in winter, but the lower portions persist until the following summer. The stem has both the carinal and vallecular collenchyma well developed. The sheaths from lower portions of the stem are encircled at their midregions by a black girdle. In all characters *E.* × *ferrissii* approaches complete intermediacy between its parents, *E. hyemale* var. *affine* and *E. laevigatum*. This widespread hybrid is found in Connecticut, New York, New Jersey, Virginia, and Maryland, and from Ontario and Michigan to Ohio, Indiana, Missouri, Arkansas, Oklahoma, Texas and northern Mexico to British Columbia, California, and Baja California.

Equisetum × *ferrissii* has been the source of much confusion in *Hippochaete* taxonomy and was discussed at greater length in a recent paper (Hauke, 1960).

V. EQUISETUM × TRACHYODON A. Br. Flora **22**: 305. 1839 (*pro sp.*).

E. hyemale × *variegatum*.

E. hyemale β mackaii Newm. Phytologist **1**: 305. 1843 (Sept. 1842).

E. hiemale var. *doellii* Milde, Verh. Zool.–Bot. Ges. Wien **13**: 493. 1863.

E. variegatum var. *jesupii* A. A. Eat. in Gilbert, List of N. Amer. Pterid. 27. 1901.

The stems of this hybrid are of medium height, slender to rather stout, unbranched, and evergreen. The ridges bear two rows of silica tubercles, usually separated by a central furrow. The sheaths are black, or black-girdled and white above; the sheath segments have a prominent median furrow, and the teeth have the prominent white margins characteristic of *E. variegatum,* but differ from those of that species in having hair-like tips. On old stems the sheaths become thin and white or break off.

The most widespread of *Hippochaete* hybrids, *E.* × *trachyodon* is found on two continents. In North America it ranges from British Columbia across southern Canada to Newfoundland, and south to Oregon, Montana, and Wyoming. Absent from the Mississippi basin, it occurs in the Great Lakes region south to northern Indiana and Ohio, and in New York, New Jersey, and New England. It is found also in Iceland and Greenland, and is known in Europe from Scandinavia, Britain, northern France, Germany, Switzerland, Czechoslovakia, Latvia, and Hungary. The occurrence in Greenland, in the absence of *E. hyemale*, is noteworthy. Schaffner (1931) mentioned that it was found near old Norse farms, and attributed its presence there to accidental transport with hay brought in from Iceland or Norway.

Equisetum × *trachyodon* in North America has usually been called *E. variegatum* var. *jesupii.* It does differ from the European *E.* × *trachyodon*, having a somewhat higher mean ridge number and shorter mean sheath length. These differences reflect the difference between *E. hyemale* var. *affine* and *E. hyemale* var. *hyemale*. They are so slight, however, that it is not possible to tell the place of origin of a specimen by looking at it. Consequently all hybrids between *E. hyemale* and *E. variegatum*

are here grouped under the one name, *E.* × *trachyodon.*

The hybrid nature of *E.* × *trachyodon* has long been suspected, and Manton (1950) pictured the complete failure of pairing at meiosis, offering this as proof of its hybrid origin.

Young stems of this hybrid resemble *E. variegatum,* but when they get older they look more like *E. hyemale.* Specimens of *E.* × *trachyodon* are confused occasionally with *E.* × *moorei* or *E.* × *nelsonii,* but the frequently bituberculate condition of the ridges separate it readily from the latter, and the *variegatum*-like teeth distinguish it from the former.

VI. EQUISETUM × NELSONII (A. A. Eat.) Schaffn. Amer. Fern Journ. **16**: 45. 1926 (*pro sp.*).

E. laevigatum × *variegatum.*

E. variegatum var. *nelsonii* A. A. Eat. Fern Bull. **12**: 41. 1904.

The smooth, thin, unbranched, deciduous stems of medium height, and the green sheaths bearing teeth with wide white margins characterize this hybrid. It has been collected in New York, Quebec, Ontario, Michigan, and around the southern tip of Lake Michigan, in Wisconsin, Minnesota, Wyoming, Montana, and Oregon. The presence of this hybrid in New York and Quebec is probably an indication of transport of stem or rhizome segments via the St. Lawrence River and the New York Barge Canal (as discussed for *E.* × *ferrissii,* in Hauke, 1960).

Though resembling *E. variegatum, E.* × *nelsonii* has deciduous stems and lacks a median furrow on its ridges. It has been mistaken for *E.* × *trachyodon* but that hybrid also has evergreen stems with median ridge-furrows. There are other differences—the longer, funnelform sheaths, the greater development of vallecular collenchyma, and the lighter green color — which separate *E.* × *nelsonii* from *E.* × *trachyodon.* Caespitose forms of *E.* × *ferrissii* show a striking similarity to *E.* × *nelsonii,* and the only way I know to distinguish them is by the rhizome; *E.* × *nelsonii* usually inherits the smooth black rhizome of *E. variegatum,* whereas *E.* × *ferrissii* has the rough rhizome surface characteristic of most *Hippochaete.*

VII. EQUISETUM RAMOSISSIMUM × VARIEGATUM.

Hippochaete × *naegelianum* (W. Koch) Rothm. Repert. Sp. Nov. Fedde. **54**: 81. 1944, probably. (Type not seen.)

Only one specimen[1] has been seen that appears to have this parentage. It has thin, unbranched, deciduous stems with funnelform green sheaths. The last two characters, expected in a hybrid with *E. ramosissimum* subsp. *ramosissimum* as one parent but not in a hybrid with *E. hyemale* as one parent, differentiate it from *E.* × *trachyodon*. All specimens I have seen that have been identified as this hybrid are actually *E.* × *trachyodon*, the only specimen belonging here having been labeled *E. variegatum*. Still, it is possible that some collections here considered *E.* × *trachyodon* are actually from deciduous plants and should be included under this formula.

This hybrid would be expected to have a limited range and to occur infrequently, for the ranges of the parents overlap only slightly. Even in Switzerland, where both are common, *E. variegatum* is found mostly above 1000 meters elevation and *E. ramosissimum* mostly below 500 meters. Consequently contact between the two species must be limited.

Since this is such a rare hybrid, I classify it under its formula rather than under a specific epithet. In fact, I include this hybrid only tentatively, because it seems unwise to base the existence of hybridization on a single specimen.

CONCLUSION

The descriptions of the six, possibly seven, hybrids between species of *Equisetum*, subgenus *Hippochaete*, completes this resumé of the taxonomic conclusions reached through a monographic study of this group. It is hoped that the proper identification of these plants will be easier because of this work, and that both amateur and professional botanists will collect and study scouring rushes now that the species have been redefined.

I am grateful to Dr. Warren H. Wagner, Jr., for extensive help given me during this study.

[1] Switzerland: Corcellettes, Vaud, sur les dunes couvertes de buissons du bord du lac, alt. c. 435 m. (Sta. 6), *A. Maillefer*, 14 Sept. 1932 (OS).

LITERATURE CITED

HAUKE, R. L. 1960. The Smooth Scouring Rush and Its Complexities. Amer. Fern Journ. **50**: 185–193.

MANTON, I. 1950. Problems of Cytology and Evolution in the Pteridophyta. Cambridge University Press.

MILDE, J. 1867. Monographia Equisetorum. Nova Acta Acad. Leop.-Carol. **32**(2).

SCHAFFNER, J. H. 1931. Studies of Equiseta in European Herbaria. Amer. Fern Journ. **21**: 90–102.

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Shorter Notes

COLLECTING MARATTIA EXCAVATA IN COSTA RICA.—In 1958 I received a request from P. C. Hutchison and Myron Kimnach, who are busily engaged in building up the living collection of ferns at the University of California Botanical Garden in Berkeley, California, for a live specimen of *Marattia*. Having read in Standley's Flora of Costa Rica that one of the most primitive ferns, *Marattia*, had been found on the Cerro de la Carpintera, I had scaled the steep range on December 31, 1957, just a few days prior to the university request, and I had found the plants and taken one small live specimen, which, however, due to the confusion of caring for all kinds of plants unfortunately was neglected and died. I therefore prepared for another ascent of this treacherous mountain on January 10, 1958.

The cloud-forest on the Cerro de la Carpintera ranges down almost to the village of San Ramón de Tres Ríos at its base, at an altitude of 1390 meters. The crest, 1880 meters high, often remains hidden by black rain-clouds. The lower slopes are partly planted with coffee and partly serve as cattle pastures. The drier western slopes are covered with tall and thorny thickets, but the eastern slopes are wet, and the pasture consists of green, dripping wet mats of grass. Orchids, bromeliads,

and ferns thickly coat the few trees left on the lower slopes. Higher up in the forest, fogs, drizzle rains, and downpours regularly drench the eastern as well as the southern slopes day and night. There are only a very few really dry weeks during the course of a year. The climatic seasons are reversed in Central America from those of northern South America, and when the dry season begins there the rains begin in Central America. This is in April, when the rains from the Pacific sweep in from the west, and thereafter rains from both the Atlantic and Pacific Oceans alternate or frequently blend. This position of the Cerro de la Carpintera on the Continental Divide between two climatic zones gives rise to a vegetation unparalleled elsewhere.

In ascending the mountain one can observe perhaps five different vegetation zones, each influenced by its special factors of temperature, wind-drift, elevation, precipitation, and exposure. The plant species are a mixture of Atlantic coast and Pacific species, and include also many endemics. On the eastern summit occur many ferns—species of *Asplenium, Blechnum, Danaea, Nephrolepis, Lycopodium, Trichomanes, Hymenophyllum,* and many others. On the central ridge extending north is the cloud-forest, where the silence is broken only by the far shouts of a few howler monkeys. Here in the fog grows *Marattia.* It is a rare plant in this gloomy place, brightened only by a few pendent spikes of the heavy yellow flowers of the orchid *Acineta densa* and the red blossoms of a *Columnea.* About a half dozen specimens of *Marattia* were located. The heavy, globular trunk is almost entirely buried under the humus; the large fronds are not unlike those of a giant bracken, only fleshier. Excavating a trunk and getting down the mountain was a laborious task, successfully accomplished. The plants reached Berkeley in good condition and are now growing in the greenhouse of the Botanical Garden, possibly the only plants of *Marattia* in cultivation in the United States.—CLARENCE K. HORICH, *San José, Costa Rica.*

Recent Fern Literature

MARSILEALES AND SALVINIALES—"LIVING FOSSILS"?—Under this intriguing title Dr. A. D. J. Meeuse, of the University of Amsterdam, has published[1] a paper of value to those interested in phylogenetic speculations. Dr. Meeuse states that a close relationship between either *Marsilea* or *Salvinia* to the true ferns (Filices) has never been demonstrated. They have a number of peculiar characters that can be interpreted as extremely primitive. In 1930, Zimmerman advanced the idea that *Marsilea* might be a descendent of the Caytoniales, an extinct, advanced order of the seed ferns (Pteridospermae), but this has since been challenged. Meeuse advances the reverse hypothesis, that the Caytoniales were descended from a primitive stock of the Glossopteridales, of which *Marsilea* is a surviving representative. The reproduction of the Glossopteridales is insufficiently known, but they did, like *Marsilea*, have a rhizomatous stem producing fronds of which the fertile ones bear several stalked sporangium-bearing organs in the basal portion. The frond segments of *Marsilea* are similar to those of the form-genus *Sagenopteris* and the venation is "glossopteroid." Similarly, *Salvinia* and *Azolla* can be interpreted as descendants of the Lyginopteridales, another order of the Pteridospermae. The megasporangium is suggestive of that of *Lagenostoma* and the microsporangium of that of the recently discovered *Saarotheca*, and the venation is "neuropteroid." If true, this would make *Marsilea* and *Salvinia* living representatives of the Pteridospermae, and thus "living fossils" in the same sense that *Isoëtes*, *Equisetum*, and *Psilotum* are living representatives of primitive groups that are otherwise long extinct. Meeuse explains the persistence of *Marsilea* and *Salvinia* as due to their aquatic habitat, where the competition with the more recent and successful gymnosperms and angiosperms has not been so keen, and also to their facile vegetative reproduction, *too* facile as is

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[1] Acta Bot. Neerl. **10**[3]: 257–260. 1961.

at present being demonstrated by the unprecedented and harmful growth of *Salvinia* in Lake Kariba,[2] in Northern Rhodesia, where it is continuing to fill up the lake rapidly. A recent suggestion for controlling such aquatic pests is the introduction of our southern "sea-cow" or manatee, an aquatic mammal which is a prodigious eater of vegetation.[3]—C. V. Morton.

TROPICS MAGAZINE[1] is a new publication dealing with the tropics in general, in particular with tropical plants and gardening. The first number contains articles on staghorn ferns, gesneriads, bromeliads, and aroids. It will be of interest to members living in Florida or those growing tropical plants in greenhouses.

Notes and News

RICHARD C. HARLOW: 1889–1962—Obituary notices of a famous football coach appeared a few weeks ago on the sports pages of newspapers the country over. Why should this lead to these lines in a quite different periodical? Because they concerned Richard C. Harlow. He was born in Philadelphia in 1889 and studied at Pennsylvania State College where his interest was awakened in nature study as a hobby. For many years he traveled far and wide observing the nesting habits of birds. Then, in the 1930's, while coaching at Harvard University, he chanced to meet our revered members, the Weatherbys, who stimulated in him an interest in ferns. He joined our Society in 1940, but withdrew when ill health came on.

Dick Harlow built a marvellous fern garden at his summer home near South Sterling, Pennsylvania. Being an extraordinary "finder," he soon had this filled with rare species and hybrids. Whenever a report of something new appeared, he

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[2] "Fern Monster?" THIS JOURNAL **51**: 53. 1961.

[3] Alssopp, W. H. L. The Manatee—ecology and use for weed control. Nature **188**: 762. 1960.

[1] Vol. 1, no. 1. pp. 1–65. June, 1962. P. O. Box 435, Coconut Grove 33, Florida. Subscription $4.00 a year ($4.50 foreign).

promptly got in touch with the discoverer and arranged to obtain a rhizome for his collection, which became the most complete in the middle Atlantic States. Always welcoming visitors, he had fern enthusiasts come from far and wide to accept a "guided tour." (Incredible as it may seem, he found that labelling individual rarities led to vandalism).

Alas, in recent years circulatory disturbances curtailed his activities and he passed away in a Naval Hospital on February 10, 1962.—E. T. W.

RECENT DEATHS.—Word has reached the Treasurer since printing of Volume 52 Number 2, that Mrs. Anson S. Blake, of Berkeley, California, and a member of the Fern Society since 1945, has passed away. Mrs. Blake had been a regular attendant at the meetings of the California Botanical Society in Berkeley for many years, and had a keen interest in both native and introduced ferns suitable for garden culture.

Dr. Alan Johnston, of Martinsville, Indiana, who joined the American Fern Society only last year, also has died recently. The members of the American Fern Society extend their sincere condolences to the relatives and friends of our two departed members.—I. L. W.

LOST ADDRESS.—Miss Mary F. Wright joined the American Fern Society in 1925 and her last known address was 231 Winona Street, Philadelphia 44, Penn. Recent numbers of the Fern Journal have been returned without any information regarding a move or whether or not Miss Wright is still living. Any friends or acquaintances who have information about her will do the Council a favor by sending a note to the Treasurer or to the Editor.—I. L. W.

American Fern Society

NEW OFFICERS OF THE AMERICAN FERN SOCIETY.—Almost before Dr. H. L. Blomquist, elected to the presidency of the American Fern Society last fall, could assume that office, ill health forced him to resign. With sincere and deep regret the Council felt constrained to accept his resignation, tendered late in January, 1962.

Under the terms of the Constitution of the Society, the Vice-President becomes President when the president resigns or is unable to complete his regular term of office. It is then the responsibility of the Council to appoint a new Vice-President to serve out the remainder of the term vacated by the individual elevated from the Vice-President's to President's office. In compliance with these regulations, Dr. Robert C. Lommasson, Professor of Botany at the University of Nebraska, is now serving as President, and his name appears at the head of the list of officers constituting the Council for 1962, printed on the inside front cover of this issue of the Fern Journal. The Council acted favorably on the recommendation of President Lommasson that Dr. Donovan S. Correll, Chief Botanist and Head of the Botanical Laboratories of the Texas Research Foundation, be appointed Vice-President to serve the unexpired portion of the 1962 term. Dr. Correll's name also appears in the revised list of Officers.

The Council extends its best wishes to Dr. Blomquist with the hope that reduction in some of his duties has already made possible rapid improvement in his health, and that total return to full health will occur soon. It communicates, with regret, the information that our regularly elected President of last autumn was unable to serve out his full term of office. The three members of the Council not personally involved in the shift and new appointment, commend our new President and Vice-President to the members of the American Fern Society, with full confidence in their ability to guide the affairs of the Society.—I.L.W.

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Suggestions to Contributors to the American Fern Journal

1. Authors of papers submitted to the *American Fern Journal* should consult the *Style Manual for Biological Journals* (1960) and be guided by its examples.

2. The "name-and-year" system for bibliographic references will, except in exceptional cases, be used. (See Literature Cited below for an example).

3. Authors are encouraged to use the journal abbreviations set forth by Schwarten and Rickett (1958, 1961).

4. Abbreviations of names of herbaria will be those listed by Lanjouw and Stafleu (1959).

5. Reports of chromosome numbers will not be accepted unless documented.

6. The use of footnotes and tabular matter should be kept to a minimum.

7. All manuscripts submitted for publication should be typed, double-spaced, and have ample margins.

8. Reprints should be ordered when galley proof is returned to the Editor. An order blank will be included with the galley proof.

Literature Cited

American Institute of Biological Sciences, Committee on Form and Style of the Conference of Biological Editors. 1960. Style Manual for Biological Journals. American Institute of Biological Sciences. Washington, D. C. 100 p.

Lanjouw, J., and F. A. Stafleu. 1959. The Herbaria of the World. Index Herbariorum, Regnum Veg. **15**: 1-249.

Schwarten, L., and H. W. Ricket. 1958. Abbreviations of Titles of Serials Cited by Botanists. Bull. Torrey Club **85**: 277-300; 1961. Supplement I. Ibid. **88**: 1-10.

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IRA L. WIGGINS

C. V. MORTON ROLLA M. TRYON

JOHN H. THOMAS

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American Fern Journal

VOL. 52 OCTOBER-DECEMBER, 1962 NO. 4

More Florida Rarities

THOMAS DARLING, JR.

Recently (Darling, 1961), under the title "Florida Rarities," I described the results of five fern hunting trips to Florida, the first in 1941, and the other four from 1955 through 1958. This sequel describes my later expeditions of 1959 and 1960.

Again I chose November of each year to visit relatives on Longboat Key near Sarasota, but my explorations covered the state from Gainesville to the Florida Keys. In 1959 my first objective was to look up Dr. E. S. Ford, of the University of Florida at Gainesville, to continue our previous year's search for the so-called "Fern Cave," where the St. John brothers had found rare Aspleniums identical with, or at least similar to, those at Maynard's Cave at Lecanto, i.e. *A. plenum* and *A. subtile*. At the University herbarium were interesting specimens of these rarities, collected April 15, 1942, with this observation in Edward St. John's handwriting: "Note this *second* station (St. John, 1943, p. 62), Fern Cave, a few miles northeast of Newberry. It is quite important! *Blechnum occidentale* is also found at the entrance."

Since our futile search in 1958 both Dr. Ford and I had done some research in an effort to pinpoint the location of this cave, since local residents knew nothing about it. We finally concluded (from correspondence with a former associate of the St. John brothers who had once visited the spot and from Dr. Ford's study of aerial maps) that the location was nearer High Springs than Newberry. We spent an entire afternoon looking for it and had about given up when Dr. Ford called out, "I think I've found it!" When I joined him, I realized that Fern Cave is in reality

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a huge vertical shaft or sink hole of terrifying aspect, which drops sheer off in the middle of a field. A luxuriant growth of the rare *Blechnum occidentale* at the entrance left little doubt that we had found the right place, but further exploration without ropes was out of the question. Far down the face of the perpendicular rock wall we could see unidentifiable ferns. I learned later that when these were collected by a party with the aid of ropes, they proved to be the common *Asplenium abscissum*, with no trace of either *A. plenum* or *A. subtile*. (I have seen pressed specimens of "*A. scalifolium*," which the St. John brothers considered a third Lecanto "endemic," but they appear to be either *A. verecundum* or *A. Curtissii*.)

Journeying south from Gainesville, I encountered two examples of the way in which rare plants are being exterminated by so-called "progress." Dr. Ford had told me where *Ophioglossum crotalophoroides* could be found by the roadside, but upon reaching the general area I realized that road-widening operations had obliterated the entire colony of this little Bulbous Adder's Tongue. Then, at a point south of Ocala, I made my way to the former location of Belleview Cave, one of the few spots where the St. John brothers had found *Asplenium Curtissii*. Nearing the region, I was horrified to see bulldozers in action. Dump trucks were carting material from a thriving rock quarry amidst destruction of the surrounding hammock. Observing a man standing nearby, I asked whether he knew the location of Belleview Cave. He pointed into the midst of the quarrying operations and said that up until two months earlier it used to be at that very spot!

Continuing southward, following Dr. Ford's directions, I visited Cat Hammock, near Sumterville, former haunt of the St. John brothers in their search for rare ferns. Here for the first time I found *Asplenium Curtissii* in the same form which so delighted the oldtime botanists by its luxuriance at Buzzard's Roost and Pineola Grottoes. One plant in particular (with many fronds, growing in rich humus) attained a height of 15 inches or more, the median length designated by Small and other authorities.

This fern is extremely difficult to locate in Cat Hammock. I had attempted to find it on two previous visits, without success.

Friday, November thirteenth, far from being unlucky, turned out to be an extra special red-letter day. I had obtained a room at Lake Panasoffkee in a cabin overlooking the lake. When I awoke, Dr. Ford was waiting to join me, having driven down from Gainesville at an early hour. First, we explored the area north of the Outlet where *Asplenium cristatum* and *A. abscissum* grow together in local profusion. We searched the low boulders carefully, but could see no sign of a hybrid. We revisited Cat Hammock, discovering more *A. Curtissii* in the local sink-holes. Here *A. heterochroum* was also to be seen. Then we continued to Indian Field Ledges, where the Aspleniums found during a previous visit were still in evidence. *Asplenium abscissum* and *A. verecundum* were common everywhere, and *A. plenum* was luxuriant on "the ridge," a long low-lying boulder, with *A. Curtissii* less plentiful on rocks to the southwest.

At Battle Slough, just east of the Withlacoochee River, we spent some time searching for the rare filmy fern, *Trichomanes sphenoides*. In view of the northern latitude, this is a most unusual location for this representative of the "filmies." Otherwise, it is known only from the West Indies and Central and South America. The area where we searched was drying out rapidly due to cutting of shade-giving magnolias. However, we finally located a few specimens of this rare fern on moss-covered boulders. There unfortunately appears little chance of ultimate survival—another instance of extermination by the encroachment of civilization.

In mid-afternoon Dr. Ford drove back to Gainesville and I continued to Floral City, it being my intention to inquire about the possibility of visiting Craig's Island in Lake Tsala Apopka over the weekend. Here many years ago the St. John brothers had found *Asplenium cristatum* and a luxuriant form of *A. pumilum* growing together on moss-covered boulders near the water's edge. Once I discussed this with John Beckner of St. Petersburg, horticulturist, student of Florida ferns, and member

of the American Fern Society. He had never visited Craig's Island, nor did he know its location, but suggested that if one could rent a boat and had sufficient time to explore the islands of Tsala Apopka, it might be possible to sight these plants, since they were presumably visible from the lake.

At Floral City a local resident told me he knew the location of Craig's Island, but that the lake was so high because of rains that in all probability the island was flooded. He referred me to a competent guide who might take me on a voyage of exploration on a boat known as an "air sled," a fast method of aquatic transportation. In the late afternoon I got in touch with the owner and suggested going for a tour of the lake during the weekend, but he proved to be unavailable Saturday and Sunday.

"I can take you out right now before dark," he told me, "and that's the only time I could arrange it."

Accepting his invitation on the spur of the moment, I soon found myself skimming over Lake Tsala Apopka at an alarming speed. Right and left turns were a real sensation in this unique craft. The operator sat up front on a high seat with the passenger standing behind him clinging on for dear life! In this manner we roared through saw-grass, weeds, cattails, and aquatic shrubs in amazing fashion. Even with the high water we would sometimes head straight for a brushy area and force our way through with ominous crackling and splintering sounds.

En route I explained to my guide about the rocky terrain of Craig's Island as the St. John brothers described it.

"You probably mean Fowler's Island," he said. "There's no rocks on Craig's."

I insisted that herbarium specimens of the rare ferns were definitely labeled from Craig's, so we bypassed Fowler's and headed for Craig's. Disembarking at the latter, we found that the island had recently been inundated and threaded our way over the mucky surface. I soon realized that our search was hopeless, since no rocks or boulders were to be seen.

As the sun sank low on the horizon, it appeared as if the quest were in vain. My guide asked whether I wanted to make a quick

stop at Fowler's Island on the return trip. Since there was nothing to lose, I agreed. At the island, following a rough jungle path to the rocky point, my guide grumbled at the prevalence of rattlesnakes in the area and kept beating the trail ahead with a club. Just as it was getting dark we reached our destination and I could scarcely believe my eyes! There on the low moss-covered boulders near the water's edge, as described by the old-time botanists, were beautiful specimens of *Asplenium cristatum* and the luxuriant form of *A. pumilum*. It seems that with the passing years the island had changed its name, at least as far as the present generation is concerned!

The next day was as unsuccessful as Friday the thirteenth had proved profitable. Visiting Maynard's Cave at Lecanto, site of the rare Aspleniums previously mentioned, I found the cave in poor condition, with little moisture, completely devoid of the interesting ferns. Then, at Chinsegut Hill, near Brooksville, I spent a futile search for *Pityrogramma calomelanos,* the Silver Fern, formerly reported from this region.

North of St. Petersburg, in a marshy area along the main highway, I saw the Carolina Club Moss (*Lycopodium carolinianum*) growing side by side with *Lycopodium cernuum*, the Staghorn Lycopod. South of Tampa, along the Balm Road, these same two fern allies were in evidence, together with the extremely rare *Dicranopteris flexuosa* (Net Fern) which I had seen on a previous trip (Darling, 1961).

Following a brief visit with my relatives on Longboat Key I drove to Miami, arriving in the midst of a tropical downpour which continued without letup all night. From my motel room it sounded as if giant fire hoses were being turned against the walls. Eleven inches of rain fell within a period of 24 hours—a record, I believe, for this area. Next day the papers featured the headline: "Miami Drown, But Not Out!" Since it was impossible to botanize, I spent most of the time at the University herbarium checking fern locations.

The following day I went to Everglades National Park to join Dr. Frank Craighead, now retired and a volunteer research

worker on the Park staff, in a search for the supposedly locally extinct Fragrant Maidenhair, *Adiantum melanoleucum*. Rumor had it that this plant had been seen recently within the Park boundaries, where it is strictly protected by law (Darling, 1961). A visit to likely hammocks harboring erosion holes favorable to its growth proved fruitless, but Dr. Craighead promised to keep on the lookout for this elusive rarity.

November twenty-first proved to be another red-letter day. With three enthusiasts from the Miami area, C. E. Delchamps, Monroe Birdsey, and C. F. Dowling, I toured the region from South Miami to Naranja, and in the course of a day was shown the following unusually scarce ferns: *Cheilanthes microphylla*, *Ctenitis submarginalis*, *Meniscium serratum*, and *Cheiroglossa palmata* (the Hand Fern). Also, much to my amazement, in a long-overlooked hammock recently discovered by Delchamps near the Plant Introduction Station, there were present in local profusion the following ferns which formerly I had considered nearly extinct: *Asplenium biscayneanum*, *Stenochlaena Kunzeana* (Holly Fern) and the Giant Bracken, *Litobrochia* (*Pteris*) *tripartita*.

Late that afternoon I drove to Bonita Springs, above Naples on the Gulf coast, and spent the night at a motel near the Collier-Lee county line. Early the next morning I joined John Beckner, E. M. Shields, John Hall, and Dr. Luer on an expedition into the Big Cypress Swamp, officially designated as Fahkahatchie Cypress, near Copeland. Wading waist deep in an area dominated by stately Royal Palms, we found many unusual epiphytic orchids on the trunks and branches of the trees. Here the Wild Birdnest Fern, *Asplenium serratum*, was abundant. Much scarcer, but occasionally growing as an epiphyte on the trunks of Royal Palms and elsewhere, was the Costate Strap Fern, *Polypodium* (*Campyloneuron*) *costatum*. We did not see either *Asplenium auritum* or *Polypodium angustifolium*, the Narrow-leaved Strap Fern, also known from this region.

Before leaving for Florida I had written Dr. Warren H. Wagner, Jr., of the University of Michigan, asking which of the

Florida Aspleniums I should send him in the form of living plants for cytological study in attempting to unravel the mystery of the *abscissum-Curtissii-verecundum* complex and thus perhaps explain the origin of probable hybrids, including the controversial Lecanto Spleenworts. I left before Dr. Wagner had a chance to reply, but during the Big Cypress trip Eddie Shields handed me a letter from C. V. Morton saying that Dr. Wagner was anxious to receive living plants of *all* Florida Aspleniums. Although my trip was now practically over, I had fortunately decided to look for and send him all species obtainable. These incuded *A. abscissum*, *A. biscayneanum*, *A. cristatum*, *A. Curtissii*, *A. dentatum*, *A. heterochroum*, *A. platyneuron* (var. *bacculum-rubrum*), *A. plenum*, *A. pumilum*, *A. serratum* and *A. verecundum*. I also forwarded a living plant of *A. auritum* from the Big Cypress given me by C. E. Delchamps of the University of Miami. Although most of the above species reached Dr. Wagner safely en route north, a few were frostbitten and badly damaged in the freezing weather of a Michigan autumn, and *A. plenum* and *A. heterochroum* had died from exposure to the cold, necessitating later replacements.

November, 1960, brought to a conclusion my six consecutive years of fern study and exploration in Florida. Very few new species remained to be seen. I did, however, make a point of revisiting Cat Hammock and Indian Field Ledges to collect living specimens of *A. heterochroum* and *A. plenum* for shipment to Ann Arbor to replace those which had perished of frostbite the preceding year. To insure the safe transportation of *A. plenum*, the rarer of the two, I collected sufficient material from Indian Field to employ a "staggered shipment" technique. Five separate packages were sent from different post offices on different dates via various types of mailing—first class, air mail, and parcel post. I was glad to learn that this effort was rewarded by the arrival of at least two living specimens of *A. plenum* in satisfactory condition for cytological study. The single shipment of *A. heterochroum* also arrived safely.

Recent correspondence with Dr. Wagner indicates interesting

developments in this research. It is anticipated that his conclusions will soon be summarized and released for publication—the first scientific study to be made of living Florida Aspleniums and their hybrids. These plants were previously unknown cytologically and some have been quite controversial taxonomically. As for the cytology of *A. heterochroum*, that is a story in itself. Material furnished by Dr. Ford and myself provided the basis for an interesting project by Miss Virginia Morzenti[1], a research student at Ann Arbor. The results should be published in the near future.

At Hillsborough River State Park, near Zephyrhills, I stopped to collect, by permission, the northern form of *Asplenium auritum* which I had seen five years previously (Darling, 1961). But I was doomed to disappointment! Although I was positive about the exact spot where a thriving colony of this intriguing fern used to grow on the stub of a dead live-oak, it was nowhere to be seen. The tree (together with the rare fern) had disappeared, possibly the victim of a hurricane.

En route from Sarasota to Miami I saw a thriving colony of both pinnate and bipinnate forms of *Diplazium esculentum* north of Arcadia in a live-oak hammock along the bank of a stream.

Continuing to the Archbold Biological Station at Lake Placid, I looked up Leonard J. Brass. Since this well known botanist is frequently away on expeditions, especially to New Guinea, I had missed him in previous years. He drove me to Bootheel Creek nearby to see a colony of *Thelypteris unca* growing with *T. palustris* and *Anchistea virginica* (Virginia Chain Fern). That evening Mr. Richard Archbold, President of Archbold Expeditions, affiliated with the American Museum of Natural History,

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[1]Miss Morzenti and Dr. Wagner have published a brief abstract of the results of this study (ASB Bull. **9**: 40-41. (April) 1962). Since the completion of Miss Morzenti's work on Dr. Ford's and my plants, further studies of collections of *Asplenium heterochroum* and *A. resiliens* by Dr. Wagner of plants, living and dried, from various localities in the southeastern United States indicate that we have an unusually complicated taxonomic situation here, in which at least one undescribed species, and perhaps more, are present.

invited me to join him and members of the staff at dinner, after which I continued to Miami.

Renewing my acquaintance with Gene Delchamps, the University of Miami chemistry instructor who has made so many unusual discoveries of local ferns in recent years, I accompanied him on an expedition to Key Largo to search for that extreme rarity, *Paltonium lanceolatum*, the Ribbon Fern. Originally listed by Small only from Old Rhodes Key and Elliotts Key, this unique epiphyte was considered "otherwise unknown in our range, but widely distributed in continental and insular tropical America." Following up a rumor that this fern, after being "lost" to science for many decades, had recently turned up in a mangrove swamp on Key Largo, Delchamps located the discoverer and got specific directions how to reach the locality. After fighting our way through almost impassable terrain, later necessitating actually climbing high into the mangrove trees and looking *down* upon the various epiphytic plants, including many kinds of orchids, we finally discovered one small non-fruiting *Paltonium* on a horizontal branch. Extensive search failed to reveal fertile specimens, or in fact, any more Ribbon Ferns at all.

In the Miami area we revisited the previously mentioned hammock near the Plant Introduction Station, only to find that Hurricane Donna earlier in the year had taken its toll. The destruction and damage wrought by this storm were unbelievable. Broken fragments of *Asplenium biscayncanum* and the Holly Fern (*Stenochlaena*) were to be seen here and there amidst the debris. It will take a long time for conditions to return to normal, if indeed a complete recovery is ever made.

In a lime sink near the Homestead Air Base *Selaginella armata* (*S. Eatonii*) was in evidence with its conspicuous mats of delicate light green.

Further to the west we explored what is left of the formerly extensive and beautiful Nixon-Lewis Hammock, gradually being whittled away by field cultivation. Here we searched without success for *Polypodium* (*Campyloneuron*) *latum*, once found here sparingly. Some authorities do not consider this a valid species,

considering it merely a long-stiped form of the common Strap Fern, *Polypodium phyllitidis*.

In regard to that other extreme rarity, the Fragrant Maidenhair, *Adiantum melanoleucum*, which until recently had not been seen for forty or fifty years and was thought to have become extinct, Dr. Craighead had written me that following my visit, after considerable exploration he had finally discovered a few plants in a remote lime-sink within the Park boundaries. However, such was the devastation of Hurricane Donna that nearly all the ferns were destroyed. Two typical fronds broken off by the storm were sent to the National Herbarium in Washington for record purposes. Those that survived physical damage were exposed to direct sunlight following destruction of the shade trees above and were badly burned. Dr. Craighead conducted me on a tour of the hammock and showed me a few fragments of this fern in a single erosion hole—all that remained of the Fragrant Maidenhair!

The final chapter of my Florida experiences takes us once again to the Fahkahatchie Swamp area of the Big Cypress in Collier County. Gene Delchamps and Monroe Birdsey from the University, Ray Glenn, and myself comprised the group driving up from Miami. Along the Turner River, just off the Tamiami Trail, we stopped long enough to look for *Cheiroglossa palmata*, the Hand Fern, and found a few specimens in poor condition on the trunks of the cabbage palms.

Near Copeland we met Leonard Brass, who had driven down from Lake Placid to join us. We entered the cypress swamp somewhat south of the region which I had visited the preceding year, but still in the Royal Palm area. The havoc wrought by Donna was to be seen everywhere. The stately palms were stripped of their former glory and much of the epiphytic vegetation on the trunks had been shorn off—partly by the force of the wind and partly by falling fronds of the trees themselves serving as gigantic shearing knives. In vain I looked for *Polypodium costatum*, the Costate Strap Fern, sparingly in evidence the previous year. Many plants of the rare local form of the

Vanilla Orchid suffered a similar fate, their vine-like fragments hanging in shreds.

Midwinter is the best time of year to visit the Big Cypress, as the water is then at its lowest. We found the general water level about waist deep, but in open places it was well over one's head, necessitating frequent detours. Leonard Brass had with him a valuable Exakta camera, and I a Zeiss Contaflex, both designed for nature photography. Before leaving I suggested that it might be risky taking such expensive equipment into the swamp. He admitted the danger, but went on to say that the important thing was not to fall down. As luck would have it, in a treacherous spot I stumbled over a sunken log, submerging both myself and the Contaflex! Although my recovery was almost immediate, the damage was done and the camera later had to be completely rebuilt at the Zeiss factory. For me the Big Cypress has turned out to be a photographic jinx, since the preceding year I lost an Argus C3 while trying to keep track of four different types of cameras, including a movie outfit.

The highlight of the trip came when we stopped to eat lunch on a small piece of elevated ground surrounded on all sides by water and cypress knees. Not far off we detected the snout of a floating alligator. After his departure we began systematic botanizing in the area, and were delighted to find *Polypodium* (*Campyloneuron*) *angustifolium*, the Narrow-leaved Strap Fern, epiphytic on branches of a large Pondapple tree. This was the first time I had seen this fern rarity in its native habitat.

Asplenium auritum still proved as elusive as ever and remained undiscovered. Although most of the group had seen it in Big Cypress at one time or another, the locations are hard to pinpoint. Gene Delchamps later wrote that he visited this region in early March when the water was much lower, and found not only *A. auritum*, but more *Polypodium angustifolium* and a large colony of *Ctenitis submarginalis*.

As mentioned in the previous article (Darling, 1961), it is difficult for a visitor with limited time to explore and botanize as thoroughly as he might wish. Any information regarding new

discoveries of Florida rarities will be appreciated greatly by the author.

LITERATURE CITED

DARLING, THOMAS, JR. 1961. Florida Rarities. Amer. Fern Journ. **51:** 1–15.

ST. JOHN, EDWARD P. 1943. More About the Distribution of Ferns in Florida. Amer. Fern Journ. **33:** 59–67.

3809 LARNO DRIVE, BUSH HILL WOODS, ALEXANDRIA, VIRGINIA.

Taxonomic Notes on Ferns, III

C. V. MORTON

The following two Jamaican ferns, in need of usable names, were brought to my attention by Mr. George L. Proctor, who is at present engaged in writing a fern flora of Jamaica.

ANOPTERIS HEXAGONA (L.) Prantl var. **simplicior** Morton, var. nov.

A var. *hexagona* foliis minus compositis, saepe bipinnatis, pinnis 2 basalibus tantum pinnatis, pinnulis paucis saepe tantum 2-jugis, segmentis magis elongatis saepe 2–4.5 cm. longis, pinnis apicalibus simplicibus valde serratis, serraturis saepe 13–20 utrinque latere differt.

Type in the United States National Herbarium, no. 2358069, collected on the interior summit slopes of Dolphin Head, Hanover Parish, Jamaica, on limestone rocks in deep shade, at 1500–1700 feet elevation, April 11, 1955, by George R. Procter (no. 10023). Isotype presumably in the Institute of Jamaica.

Paratypes (all from Jamaica): Type locality, July 31, 1955, *Proctor 10409* (US); ibid., March 7, 1960, *Proctor 20962* (IJ). Mount Ridgway Road, Windsor, Trelawny Parish, 100–150 m., April 9, 1931, *G. S. Miller 1557* (US). Cockpit country ca. 5 miles north of Quick Step, above Aberdeen Post Office, Trelawny Parish, occasional on moist shaded limestone ledges, March 6, 1950, *Proctor 4117* (IJ).

In its most extreme form this plant seems as though it might be a good species, closely related to *A. hexagona*, but efforts to find adequate distinguishing characters have been unavailing. These large plants cited above are all from the western half of Jamaica in the Parishes of Hanover and Trelawny. Plants of typical *A. hexagona* (as represented in Plumier's plate 37) are common in eastern Jamaica, in the Parishes of Portland, St. Ann, St. Mary, and St. Catherine. They are much smaller in general and more finely divided, being always tripinnate at base, with usually four pairs of compound pinnae and 2 or 3 pairs of simple

apical ones. In var. *simplicior*, there are usually only 2 basal pairs of compound pinnae, and these are almost always only simply pinnate although occasionally one of the basal pinnules will bear a single secondary basal lobe, thus making the blade casually tripinnate at base. The lateral segments of *hexagona* are normally only 1 to 2.5 cm. long. They are rather sparingly toothed, the apical, sterile, simple pinnae usually having 8 pairs of teeth or fewer.

However, all these characters mentioned are not really different characters but are expressions of the single character of the blade being less divided in the plants of Hanover and Trelawny Parishes. Moreover, even this character is somewhat variable. A specimen from Ewarton, St. Catherine Parish (*Killip 436*, US) would on division alone have to be referred to var. *simplicior*, although it is very likely only an unusual example of var. *hexagona*, since other specimens from this vicinity (near Mount Diablo) are typical. And there are other intermediates, among which may be mentioned especially *Orcutt 7697* (US), from Glenburnie Mountain, Westmoreland Parish; from its locality (in extreme western Jamaica) and from its size this approaches closely to var. *simplicior*, yet it is fully tripinnate at the base and so I refer it to var. *hexagona*, although with some doubt.

ELAPHOGLOSSUM **denudatum** (Jenman) Maxon, comb. nov.

Acrostichum hybridum var. *denudatum* Jenman, Bull. Dept. Bot. Jamaica, II, 5: 89. 1898.

Rhizome short-creeping, up to 8 cm. long, 5 7 mm. thick, densely paleaceous; scales dark brown, shining, linear-subulate, 5-7 mm. long, essentially entire; sterile fronds subcaespitose, 15-35 cm. long, long-stipitate, the stipe half as long as blade or more, glandular-pilosulous, paleaceous when young, the scales widely spreading, linear subulate, 2-2.5 mm. long, dark brown, minutely denticulate; blades linear to linear-oblong, 8-25 cm. long, 1.7-3.5 cm. broad, long-acuminate at apex, cuneate and slightly decurrent at base; leaf tissue membranous, pale green, scarcely paleaceous, except on margins, the midrib beneath not paleaceous, the scales of the surface minute, sparse, deciduous, reduced to few-celled, glandular hairs, the marginal scales soon deciduous, subulate from a cucullate base, 1 mm. long or less, deep brown; veins ending in a hydathode short of the margin, rather distant, 5 or 6

per cm.; fertile fronds rarely found, 1 or 2 to a plant, shorter than sterile, 6.5-15 cm. long, long-stipitate, the stipe 5-8 cm. long, sometimes about equaling blade, paleaceous as in the sterile; blades oblong-linear, 4-7 cm. long, 6-10 mm. wide, acutish at apex, cuneate at base, not pubescent or paleaceous, the sterile margin very narrow.

Lectotype: Jenman did not indicate a type nor cite a specimen. As lectotype may be designated a specimen in the British Museum collected in Jamaica by R. V. Sherring labelled *Acrostichum hybridum* var. This agrees with Jenman's brief description and was almost certainly studied by him; isolectotype, US.

Jenman's conception of *Acrostichum hybridum* Bory and his description (Bull. Dept. Bot. Jam., II, **5**: 89. 1898) were based on specimens of the allied species *Elaphoglossum erinaceum* (Fée) Moore, but his var. *denudatum* is not referable to that. The variety is much closer to the African *E. hybridum*, but it does differ consistently in lacking conspicuous dark scales along the midrib beneath, and considering the geographic remoteness it is best regarded as a distinct species.

The name *Elaphoglossum denudatum* (Jenm.) Maxon appears on page 27 of Mr. George R. Proctor's "A Preliminary Check-list of Jamaican Pteridophytes" but with the non-existent name "*Acrostichum denudatum* Jenm." given as basionym and without the citation of any place of publication. Although Proctor puts the specific epithet in bold-face as a new combination, it can not be considered as published and is properly omitted from the Gray Catalog, for the "Checklist" is dated May 15, 1953, which is after the date set by the International Code of Botanical Nomenclature requiring the complete citation of basionyms for the valid publication of new combinations.

ADDITIONAL SPECIMENS EXAMINED (all US except as indicated):

JAMAICA: Epiphytes on smooth trunk of forest trees in deep ravine in mountain forest above House Hill, St. Thomas, 500-700 m., *Maxon 9076 9120 9129*. Upper southern slopes and summit of Maccasucker Bump, St. Thomas, 825-1025 m., *Maxon 9546*. On rocky bank, Second Breakfast Spring, near Tweedside, 2000 feet, *Harris 7433* (Hope Gard., US), *Maxon 903*. Vicinity of Hollymount, Mount Diablo, *Maxon 1919*. Mansfield, near Bath, 300-500 m., *Maxon 2409*. Spur of John Crow Mountains opposite Mill Bank, Portland, in deep forest on large tree-trunk, 450-625 m., *Maxon 9380*. Sin. loc., *J.P. 343* (Hope Gard.)

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Some Outdoor Ferns for the Los Angeles Area

Fay MacFadden

Los Angeles and the nearby areas have a mild, warm climate, very rarely with any freezing temperatures, and so subtropical ferns should do well so far as temperature is concerned. Still, the humidity is low except very near the ocean, and consequently there are problems. My own garden is about 15 miles inland, with conditions similar to those that prevail throughout much of the area, even though the soil may be very different in different parts of the city. In the San Fernando Valley, which is on the inland side of the Santa Monica Mountains, the summers are hotter and the winters colder and drier, and consequently there are more difficulties, and some ferns may not grow at all without very special care.

Because of the special climatic conditions mentioned above, it is well not to try to grow ferns that don't find what they like here. Most of the ferns of Europe and the eastern United States do not do well, because they need moist, humid summers, and perhaps also a rest in a cold winter. Still, the Osmundas do fairly well in Los Angeles, although they die down completely in the winter. The sensitive fern, *Onoclea sensibilis*, and the marsh fern, *Thelypteris palustris*, do fairly well and persist more or less. The shield ferns, *Dryopteris spinulosa* and its relatives, are nice the first year, but they do not grow accustomed to our winters and eventually die.

Some of the ferns from northern California do well, especially the chain-fern, *Woodwardia fimbriata*, the sword-ferns, *Polystichum munitum* and *P. Dudleyi*, and the coast polypody, *Polypodium Scouleri*. They are never luxuriant for me, but I have seen the *Woodwardia* grown in humid regions near the coast in good soil reach a height of six feet. All these ferns like leaf mold and peat, but there is a product from the High Sierras called forest humus, which should help materially in their care when used as a mulch. It is coarse and should do much to recondition the soil.

The xerophytic ferns of southern California, *Cheilanthes, Notholaena, Pityrogramma,* and so forth, do not do well in soil, but they can be made to grow in glasshouses with special care as to water and soil.

Los Angeles is noted for its *Nephrolepis cordifolia,* which was at one time planted in front of every house. It does well, but unfortunately it is often given no care. It never dies, but it turns yellow and always looks terrible and neglected.

If one must depend on a gardener, it is best to stick to tree ferns. *Dicksonia antarctica* is a lovely tree fern, of slow growth. The Cibotiums are fine ferns also. The ones from Hawaii, *C. glaucum* and *C. menziesii,* are shipped here in the form of trunks that have been cut off at the ground. They are fairly easy to grow, but all that I've attempted to start in the ground, even in good soil, have lived only a year or so. The trunks are best started in small containers in leaf mold.

The Alsophilas are probably the most satisfactory tree ferns, and stand cold fairly well; a few cold nights will blight fronds just starting to unroll, but future fronds will be normal. But sometimes just one day of very hot weather with no humidity and perhaps a little wind, and the fronds will dry up and look as though a forest fire had passed near them. However, this does not happen in canyons and near the coast or where the fern is protected. However, heat doesn't harm the plant as the fronds to come are rolled up and protected by a covering of scales.

The Australian tree fern, *Alsophila Cooperi,* grown mistakenly for years as *A. australis,* the most commonly cultivated, is a handsome plant, but is invariably planted too close to the house so that it does not have an opportunity to grow symmetrically. Now that it is so commonly planted in front of new houses and multiple units it will be like *Nephrolepis cordifolia,* live on with the same lack of care and look yellowed and neglected. With care, Alsophilas thrive, and mine have gone through the roof of the lath house.

5450 CARLIN STREET, LOS ANGELES, CALIFORNIA

Shorter Notes

A NOTE ON NEPHROLEPIS CORDIFOLIA CV. DUFFII.—The principal purpose of this note is to report the occurrence of this cultivar with fertile leaves and evidently normal spores. This is, I believe, the first time that it has been recorded as fertile. The specimens were obtained from ornamental plantings at the Zanderij Airport, Paramaribo, Surinam, in 1961 (*Tryon & Kramer 5617*, GH, P). In this material the sori are borne well back of the margin of the orbicular pinnae (or pinna-lobes), the indusia are reniform to orbicular-reniform and many of the spores appear to be normally developed.

Although this cultivar is referred to *Nephrolepis cordifolia*, this identity is not entirely certain. I had anticipated that the fertile material might afford characters by which the identity could be firmly established but this has not been the case. The principal reasons for associating 'Duffii' with *N. cordifolia* are that it originally came from the Duke of York's Island, New Guinea, where *N. cordifolia* also grows; and the cultivar has been reported as having the tuber-bearing habit of *N. cordifolia*. However, this may not be a definitive character for determining the relation of the cultivar because it does not always bear tubers; nor does *N. cordifolia* always have them. The original material of 'Duffii' did not have tubers nor were they present on any of the many plants that I have seen. It is possible that 'Duffii' is a variant of another species which may also be tuber-bearing under certain circumstances, or that the tubers in 'Duffii' represent one of the characters in which it departs from its "parent" species.

Large leaves of 'Duffii' have a single vascular bundle in the petiole. *Nephrolepis cordifolia* has 1-3 bundles while some other species, such as *N. biserrata*, have 5-7. While this character suggests an affinity of 'Duffii' and *N. cordifolia*, the number of vascular bundles needs to be determined for other Malaysian species before the relation can be considered as firmly established.

The indusia of 'Duffii' are unlike those of *Nephrolepis cordifolia*

but in this character, as in the previous, the interpretation is not clear. In *N. cordifolia* the basal sorus, on the acroscopic side, has the indusium orbicular-reniform, while the others are broadly reniform to (especially toward the apex of the pinna) lunate. If the orbicular pinnae (or pinna-lobes) of 'Duffii' represent the basal portion of a pinna (or basal portion of a forked pinna), then the shape of the indusia would be consistent with a variant of *N. cordifolia*. However, the pinnae of 'Duffii' may have originated in a different manner. The shape of the indusia then would indicate that it was a variant of some other species of *Nephrolepis*.

The proper name for this plant, although correctly given by Morton (This Journal **48**: 22. 1958) as cv. Duffii, involves some technicalities of the International Code of Botanical Nomenclature and the Code of Nomenclature for Cultivated Plants, and some discussion of these may be appropriate.

Although originally described as a species (*Nephrolepis Duffii* Moore, Gard. Chron, n.s. **9**: 622, *f. 113*. 1878) and recently treated as a form (*N. cordifolia* f. *Duffii*) it seems that Art. 71 of the Code of Botanical Nomenclature prohibits this variant from having a name as a species, variety, form, etc. Article 71 rejects names that are based on monstrosities and cv. Duffii surely is one, for it is such an extreme deviation from the normal wild type of *Nephrolepis*. Articles 2 and 5 of the Code of Nomenclature for Cultivated Plants and Article 28 of the Code of Botanical Nomenclature both imply that the category cultivar is to be used for variants arising under cultivation, rather than variants brought into cultivation from the "wild." A strict application of these rules would leave 'Duffii' without a name. It can not have a name under the Botanical Code, as a wild plant, for it is a monstrosity; and it can not have a name under the Code for Cultivated Plants for it originally came from the "wild." However, cv. Duffii should be used in anticipation of the time that the technical objections to it may be removed.

A final matter is that of the correct form of the name. Article 15 of the Code for Cultivated Plants indicates that while culti-

vars normally have a colloquial name (in this case it might be 'Duff'), they may have a Latin name providing that there was one published prior to 1959. Since it was treated by Morton as cv. Duffii in 1958, the Latin is established as the correct form. ROLLA TRYON, *Gray Herbarium, Harvard University.*

THREE FRONDS OF BOTRYCHIUM OBLIQUUM.—It is possible that the accompanying illustration and comments may add a bit to the present confusion about the *Botrychium dissectum* complex.

With too much dependence on leaf-form in the separation of this genus into species, and the endless variation within the present limitation of the species (I have a specimen of *B. dissectum* with no part of the lacy frond more than 1 mm. in width), there is small reason to be over confident in one's conclusions.

The top specimen in the illustration (Pl. 8) was a plant collected, deeply bronzed, in December in the Sourland Mountains, near Hopewell, New Jersey, and placed in a terrarium with other plants. About March 15th the growth of a new frond appeared. On April 10th the plant was transferred to a planting out of doors. The new frond was then 4 inches long. A third frond appeared about June 10th, and all three fronds grew together, on the one plant, until they were collected and pressed in November. The second growth (March 15th) is at the bottom right, the third (June 10th) at bottom left, and the one on the plant in December when the plant was taken from the wild, is at the top of the illustration.

With only a little imagination, the second growth (lower right) could be called *B. silaifolium*, or considered a variety of one of its many relatives. I draw no conclusions, but leave the photograph of the three fronds to the close consideration of pteridological ecologists.—W. L. DIX, *801 Crown Street, Morrisville, Penn.*



Three Fronds from Single Plant of Botrychium obliquum

AN UNUSUAL FERN STATION ON SOUTH MANITOU ISLAND, MICHIGAN.—One of Michigan's most unusual fern stations is located on the southwestern corner of South Manitou Island. Here in the "Valley of the Giants," so called because of a grove of huge White Cedars, have been found three species of rare ferns. The first of these, the Northern Holly Fern, *Polystichum Lonchitis* (L.) Roth, was discovered by the writer several years ago, growing along the steep, shady slopes of a forested dune. This is the only known station of this species in the Lower Peninsula of Michigan. A year later, in the same valley, the Walking Fern, *Camptosorus rhizophyllus* (L.) Link, was discovered growing luxuriantly over *decaying logs on the floor of the forest:* there are no rocks in this habitat.[1] Only one other station for this species is known in Lower Michigan. It is located in the Alpena area, on the opposite side of the state, over 150 miles to the east, where *C. rhizophyllus* grows on limestone outcrops. The third species of fern found in this unusual valley is the Green Spleenwort, *Asplenium viride* Huds., which was growing in *sandy loam beneath the giant cedars.* This is the only known location for this species in Michigan's Lower Peninsula.[2]

As all three of these species normally occur on limestone (see map), but here thrive under quite different conditions, it is of interest to describe in detail the nature of the habitat. South Manitou Island is a small island of approximately nine square miles, situated in Lake Michigan about seven miles offshore from the Sleeping Bear Dunes on the Leelanau Peninsula. The flat eastern side of the island is covered with Jack Pine. Westward from the middle of the island the ground gradually rises, reach-

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[1]Benedict, R. C. 1910. A Peculiar Habitat for Camptosorus. Torreya **10:** 13–15. Dr. Benedict reported walking fern growing on gum tree trunks.

[2]*Asplenium viride* was discovered on South Manitou Island by Dr. Warren Stoutamire, Botanist at Cranbrook Institute of Science, Bloomfield Hills, Michigan.

During June, 1961, the writer found a fourth unusual fern in the above area. This was Braun's Holly Fern, *Polystichum Braunii* (Spencer) Fée var. *Purshii* Fernald. The only other stations in Michigan for this fern are in the western part of the Upper Peninsula.



FERN STATION ON SOUTH MANITOU ISLAND ●, AND NEAREST KNOWN LOCALITIES FOR CAMPTOSORUS RHIZOPHYLLUS ■, POLYSTICHUM LONCHITIS ▲, ASPLENIUM VIRIDE ▼, AND POLYSTICHUM BRAUNII VAR. PURSHII +.

ing its highest elevation along the west coast. The western side is covered with a steep moraine over 200 feet high that extends the length of the island, rising just behind the shoreline. The plateau-like top of the moraine is covered with magnificent perched dunes, many of which are covered with a White Cedar-Balsam Fir forest. Directly east of the dunes is a rich dune forest.

South of the open dunes, in the extreme southwestern corner of the island is a section of wooded dunes of rugged topography in which steep ridges alternate with deep valleys. Pocketed directly to the east of these high, steep, wooded dunes is the "Valley of the Giants," sheltered on three sides by bluffs that rise to about 100 feet elevation. This valley is filled with magnificent White Cedars, many of which range in diameter from four to six feet and tower over 100 feet in height. The nation's largest White Cedar tree is located in this grove.

The area is deeply shaded. The floor of the valley, about 200 feet above lake level, must be close to the top of the moraine, but it is covered with a layer of sandy loam. The vegetation on the forest floor grows luxuriantly, many of the species reaching exceptional heights. There are no rocks here. One wonders, then, why these three species of ferns, usually found on limestone, thrive in this location. The explanation may lie in the fact that the bases of the islands in this area are limestone which usually forms extensive shelves and shoals just below the surface of the lake. It seems probable that the glacial ice gouged from the bedrock masses of limestone that were broken and mixed into the morainal till. As a result, Michigan has an extraordinary fern habitat.

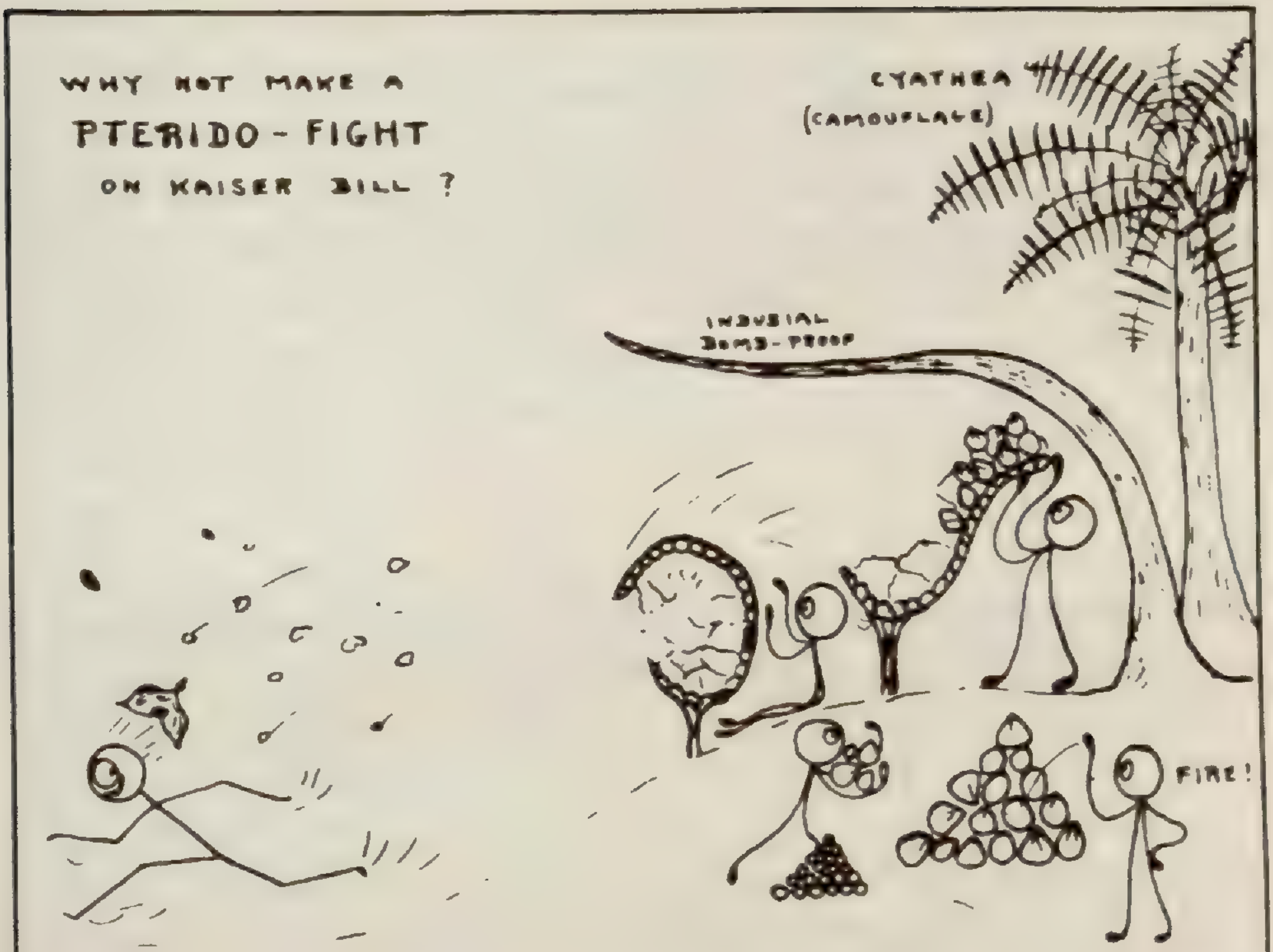
How did the ancestors of these ferns reach South Manitou Island? It is only a conjecture that their ancestors may have migrated from the area north of Lake Michigan, along a series of limestone ridges that existed during the low-water stage of the former Lake Chippewa that once occupied the Lake Michigan basin. A botanical survey of islands to the north might yield an answer to this question.—PAUL W. THOMPSON, *Cranbrook Institute of Sciences, Bloomfield Hills, Michigan.*

A LITTLE-KNOWN TALENT OF LESTER W. SHARP.—Professor Emeritus Lester W. Sharp of the Department of Botany, Cornell University, died on July 17, 1961 after a long illness. His widely-used and respected textbooks on cytology include numerous examples of his lucid drawings and diagrams which he had previously skilfully executed either to illustrate his research papers or for teaching aids. However, except in the case of his former students and colleagues, Dr. Sharp's ready wit and clever artistic talents in a lighter vein are little recognized. Perhaps his best known contribution of this type is his privately published hoax on the dawn bird, *Eoörnis pterorelox gobiensis*, based on the subject of his Cornell seminar given in disguise as a famous (and heavily bearded) foreign explorer and ornithologist. Details of this and other personalia have been mentioned recently in an obituary by Dr. Harlan Banks.[1]

On the other hand, many of Sharp's sketches, such as that shown in the accompanying cartoon, were made over 40 years ago, and thus have not been seen and appreciated by the present generation of botanists. Dr. J. R. Schramm, who was for many years a colleague of Sharp, had a small copy of this cartoon which he kindly made available to me. Because of its "Pteridophyte" subject matter, I wish to share this sketch with the members of the American Fern Society. When Dr. Schramm first showed me this cartoon, he claimed he couldn't remember the details of its inception, and so suggested that I write Professor Emeritus Arthur J. Eames at Cornell for the *raison d'être* of this sketch. Dr. Eames' obliging explanation is as follows: "The history of this cartoon is simple. During the 'teens and twenties the department staff and graduate students had many evening dinner parties in the laboratories, chiefly for our own entertainment. There was then little in the way of outside entertainment and we (the staff) were carrying a heavy teaching load. Most of the entertainment was of the humorous type and Sharp was a leader in preparing lantern slide shows. This cartoon was

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[1]Plant Science Bulletin **(8)1**: 9. 1962.



prepared, as you suggest, during the First World War. It was much appreciated by the audience."

In examining the details of Dr. Sharp's clever cartoon, it is obvious that he was quite knowledgeable about the morphological and functional features of ferns and their so-called "allies." The figures (Horse-tail Marines) firing the annulus-operated sporangial catapults are represented by *Equisetum* spores with their extended elater-like appendages. The clever reference to ammunition of two calibres made by the "Selaginella Heterospory Company" is self-explanatory.

In anticipation of future letters of protest to the editor by students of the Cyatheaceae, pointing out that the genus *Cyathea* is characterized by cup-shaped indusia and not a laterally-attached flap type (a cited feature of the genus *Hemitelia*), may I suggest that Dr. Sharp's insight in regard to the systematics of this family was far ahead of his time. For substantiation of this taxonomic acuity of Dr. Sharp the reader is referred to Holttum's recent work on Malayan ferns[2] in which he points out that the time-honored custom of separating species of the Cyatheaceae into three genera on the basis of their indusial type (or lack of one) is "quite artificial." Holttum goes on to say that "—it is therefore now more usual to place all species in one large genus *Cyathea* (the earliest of the generic names)."

Truly, it is entirely within the realm of possibility that, but for a quirk of fate which led him into emphasis on cytology, Dr. Sharp might have been (like his *Eoörnis*) one of those *rarae aves*, a pteridologist!—JAMES E. CANRIGHT, *Department of Botany, Indiana University, Bloomington, Indiana.*

Recent Fern Literature

"LOS PTERIDOFITOS O HELECHOS DE CHILE," by our Honorary Member Gualterio Looser,[1] is the first part of a complete treatment of the ferns and fern-allies of Chile. This part includes the families Equisetaceae, Lycopodiaceae, Isoëtaceae, Schizaeaceae, Marsileaceae, and Salviniaceae. The treatment is exceptionally complete, including keys and descriptions, in Spanish, and full discussions of variation, distribution, local names, ecology, geographic distribution, and citation of specimens. There are 17 plates of photographs and drawings, mostly original. When the work is completed it will be an indispensable guide to the ferns of Chile.—C.V.M.

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[2]Flora of Malaya, vol. II, Ferns, p. 115. 1954.

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[1]Revista Universitaria, Año XLVI, pp. 213–262, *fig. 1–17*. 1962. Published by the Editorial Universidad Católica de Chile, Lira 136, Santiago de Chile, Chile.

A FERN FLORA OF THE STATE OF CHIHUAHUA, MEXICO.[1]—Two members of the American Fern Society, our Vice-President and Irving W. Knobloch, have produced an attractive book on the ferns and fern-allies of Chihuahua, Mexico. They include 138 species and infra-specific taxonomic entities, with each species illustrated with line drawings. These have been done accurately, show enlarged details of diagnostic value as well as habit sketches, and will be of aid to anyone wishing to identify a specimen from the area covered.

The first 13 pages consist of introductory discussions of a number of pertinent subjects and end with a section on how to use the keys. In the taxonomic section, which requires most of the book, each taxon recognized is given a technical description and keys to species and genera are provided in each case in which there is more than one species in a genus or two or more genera in a family. Statements about habitat, range, citation of literature pertinent to the taxon and a list of specimens examined from Chihuahua, are given with each species or lower taxon included.

An appendix contains suggestions about ferns known to grow in regions near the state and to be expected in Chihuahua; a map showing the major drainage systems and towns; and an alphabetically arranged list of localities from which ferns have been collected in Chihuahua. This gazetteer lists 157 localities, and gives the latitude and longitude of each to the nearest minute. A glossary and bibliography follow, and the index indicates valid names in roman type, synonyms in italics, and the page on which the main treatment of a taxon appears in bold face.

The book is bound in red buckram and lettered in gold on the face and spine. It is a book that will be useful to anyone interested in the ferns of Mexico and is highly recommended.—I.L.W.

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[1] Ferns and Fern Allies of Chihuahua, Mexico. By Irving W. Knobloch and Donovan S. Correll. pp. XIV + 1–198, *pls.* 1–57 + *frontispiece*. Texas Research Foundation, Renner, Texas. Price $10.

American Fern Society

NORTHEASTERN SUMMER FIELD TRIP.—The Northeastern Section of the American Fern Society, under the leadership of Dr. Benjamin Allison, conducted a field trip in the vicinity of Wallingford, Vermont, July 12-14, 1962, with total attendance of 43 members and guests. Guides were Mrs. Elizabeth Newton and Mr. Henry Potter, both local people who know where to find ferns. Evening programs were arranged by Dr. Ralph C. Benedict.

The group assembled at its field headquarters, the Wallingford Inn, Thursday evening, July 12. Friday morning it explored a roadside area near South Reading, and found 22 species in a short time. The party then proceeded to the home of Mrs. Newton in Reading, where we were shown a nice stand of *Polystichum Braunii*. Many other species were noted in her garden and beside the road.

In the afternoon Mr. Potter led us to a large stand of *Dryopteris Filix-mas* near Woodstock. Mrs. Allison found a plant identified as *D. Filix-mas* × *marginalis*. It was photographed and a frond taken for further study. We were then treated to a view of the very rare *Asplenium viride*. Unfortunately, road construction is likely to endanger this stand of the dainty little spleenwort.

On Saturday we explored the roadside along the Proctorsville Gulf where we had been in 1957 and 1959. Of special interest here is the number of species that can be found in a limited area, and the abundance of *Dryopteris Goldiana* and *Athyrium thelypteroides*. Two hybrids, *Dryopteris marginalis* × *spinulosa* and *D. Goldiana* × *marginalis*, were located.

The second stop Saturday was at Summit, in a cut through solid gneiss, made by the Rutland Railroad in 1848, where *Cryptogramma Stelleri*, *Thelypteris Phegopteris*, and *Cystopteris fragilis*, along with more common ferns, grow on the moist cliffs.

In contrast to this moist spot, we next explored a rugged limestone area in Dorset where we found *Asplenium Ruta-muraria*, *A. platyneuron*, *A. Trichomanes*, *Pellaea atropurpurea*,

and *Camptosorus rhizophyllus*.

The program one evening was provided by Mr. Gordon Foster, who showed beautiful slides of greatly enlarged photographs of ferns and their sporangia. In the second, Dr. Rolla Tryon talked about common species of *Dryopteris* and some of their 15 hybrids. He discussed the characteristics by which the species and hybrids may be distinguished.

Forty-four species and varieties of ferns, including the three hybrids, were seen on the two-day trip. Fern taxonomists tell us that not more than 73 species are known to occur in the whole northeast, so perhaps we found all that are present in the immediate vicinity of Wallingford. The list of those found is as follows:

Adiantum pedatum (American Maidenhair), *Asplenium platyneuron* (Ebony Spleenwort), *A. Ruta-muraria* (Wall Rue), *A. Trichomanes* (Maidenhair Spleenwort), *A. viride* (Green Spleenwort), *Athyrium Filix-femina* (Upland Lady Fern), *A. Filix-femina* var. *rubellum* (Red-stemmed Lady Fern), *A. pycnocarpon* (Narrow-leaved Spleenwort), *A. thelypterioides* (Silvery Spleenwort), *Botrychium dissectum* (Cut-leaved Grape Fern), *B. matricariifolium* (Daisy-leaved Grape Fern), *B. obliquum* (Common Grape Fern), *B. virginianum* (Rattlesnake Fern), *Camptosorus rhizophyllus* (Walking Fern), *Cryptogramma Stelleri* (Slender Cliffbrake), *Cystopteris bulbifera* (Bulblet Bladder Fern), *C. fragilis* (Fragile Fern), *Dennstaedtia punctilobula* (Hay-scented Fern), *Dryopteris Clintoniana* (Clinton's Wood Fern), *D. cristata* (Crested Shield Fern), *D. Filix-mas* (Male Fern), *D. Goldiana* (Goldie's Fern), *D. intermedia* (Evergreen Wood Fern), *D. marginalis* (Marginal Shield Fern), *D. spinulosa* (Spinulose Wood Fern), *Matteuccia Struthiopteris* (Ostrich Fern), *Onoclea sensibilis* (Sensitive Fern), *Osmunda cinnamomea* (Cinnamon Fern), *O. Claytoniana* (Interrupted Fern), *O. regalis* (Royal Fern), *Pellaea atropurpurea* (Purple Cliffbrake), *Polypodium vulgare* (Common Polypody), *Polystichum acrostichoides* (Christmas Fern), *P. Braunii* (Braun's Holly Fern), *Pteridium aquilinum* (Bracken), *Thelypteris noveboracensis* (New York Fern), *T. palustris* (Marsh Fern), *T. Phegopteris* (Long Beech Fern), *Gymnocarpium Dryopteris* (Little Oak Fern), *Woodsia ilvensis* (Rusty Woodsia), *W. obtusa* (Blunt-lobed Woodsia), *Dryopteris marginalis* × *spinulosa*, *D. Goldiana* × *marginalis*, and *D. Filix-mas* × *marginalis*.

The following members and their guests participated in part or all of the field trips and evening sessions: Dr. and Mrs. Benjamin R. Allison, Mrs. Bertha E. Bill, Dr. R. C. Benedict, Miss Alice Bristow, Miss Helen Bristow, Mrs. Carter L. Bain, Mr. and Mrs. Nicholas Bartho, Miss F. W. Brewster

and guest, Mr. Henry Blentheim, Miss Campbell, Mrs. Orvis K. Collins, Mrs. Howard Davis, Mrs. L. L. Delafield, Dr. and Mrs. O. R. Eastman, Mr. and Mrs. Gordon Foster, Mrs. H. S. Gray, Mr. Alfred H. Gilbert, Miss Betty Gilbert, Miss Irene Graves, Mrs. Hammond, Mrs. H. M. Herron and guest, Mr. and Mrs. Harry Logan, Mrs. Elizabeth Newton, Mr. Henry Potter, Miss Elsa Potter, Miss Ruth Reed, Mrs. Charles Russell and her sister, Miss Anna E. Scudder, Mr. and Mrs. George K. Sanborn, Dr. and Mrs. Rolla Tryon, Miss Margaret Timpson, and Mrs. Quintard Taylor.

The members of the American Fern Society who enjoyed this excellent fern foray extend their warm appreciation to the people who arranged the trip, and who acted as guides, gave information about the identity and characteristics of the ferns, and to those who provided the programs during the evening sessions.—ANNA E. SCUDDER, *Waterbury, Conn.*

SUMMER FERN FORAY IN OREGON.—Members of the American Fern Society participated in a visit to the scenic Oregon coast between Newport and Carter Lake on August 24-25, prior to the AIBS meetings held at Corvallis, Oregon. Under the excellent leadership of Miss La Rea Dennis and Dr. Kenton Chambers of Oregon State University, the foray explored salt and fresh water marshes, sand dunes, coastal forest, rain forest, and *Darlingtonia* bogs. Plants of *Darlingtonia californica* were up to several feet tall and several were in flower. *Drosera* was also found in the bogs. The plants didn't have many insects to eat that day, the bog containing more botanists and cameras than insects. *Pteridium aquilinum*, *Polystichum munitum*, *Blechnum spicant*, *Equisetum telmateia*, *Athyrium filix-femina*, *Adiantum pedatum*, and *Polypodium vulgare* were common in the lush vegetation, as well as many tasty wild berries. *Botrychium silaifolium*, epiphytic *Polypodium scouleri* and *Selaginella oregana* were also found by those not too busy looking for berries.

The Fern Society members enjoying this trip were Dr. and Mrs. Donovan Correll and family, Dr. Mildred Faust, Dr. F. R. Fosberg, Dr. and Mrs. J. V. Gilkey, Mr. Neill Hall, Mrs. Barbara Joe Hoshizaki, Dr. and Mrs. Robert Lommasson and family, Miss Eva Sobol, Mrs. Frieda Wertman, Mrs. A. J. West, Dr. Jewel Moore and Miss Inez Hartsoe.

The Fern Society also sponsored a post-meeting foray which was very ably led by Dr. William Baker of the University of Idaho from August 30 to Sept. 1 into the southern Cascade range including the beautifully forested areas of Fairview Mountain and Crater Lake. In the Bohemia-Fairview Mountain area participants found *Adiantum pedatum*, *Polypodium glycyrrhiza*, *Athyrium filix-femina*, *Pteridium aquilinum*, *Polystichum munitum* and in the rockier areas *Polypodium hesperium*, *Polystichum lonchitis*, *Cheilanthes gracillima*, *Cryptogramma acrostichoides*, *Cystopteris fragilis* and a new locality for *Pityrogramma triangularis*. On the second day the lovely Salt Creek Fall area was explored and in the afternoon the group hiked up Garfield Peak over-looking Crater Lake. On the trail up the peak *Cheilanthes gracillima*, *C. siliquosa* (a new locality), *Polystichum munitum*, *P. scopulinum*, *Cryptogramma acrostichoides*, and *Cystopteris fragilis* were discovered among westerly exposed rocks.

The trip continued through Saturday morning when several stops were made during a trip around the rim of Crater Lake. Most of the time was devoted to looking for, and at, the rare *Botrychium pumicola*. The first stop was at Llao Rock, where the rarity had been seen most recently. Here the members scouring over the area had little difficulty finding several dozen plants growing in what appeared to be pure pumice. The next stop was at Cloudcap, where the fern had not been reported for over 60 years. A thorough search revealed but four or five plants. After a brief stop at Vidae Falls, the group disbanded.

Members attending this foray included Mr. Jim Baker, Dr. Mildred Faust, Dr. and Mrs. J. V. Gilkey and family, Mrs. Alice Gobin, Mr. Neill Hall, Dr. and Mrs. G Dallas Hanna, Dr. Walter Hodge, Dr. and Mrs. Takashi Hoshizaki, Dr. Donald Huttleston, Mrs. Marcella Juhren, Dr. and Mrs. Robert Lommasson and family, Dr. Howard Reynolds, Dr. Robert Rodin, Miss Eva Sobol, Mrs. Hertha Solmitz, Mrs. A. J. West, Dr. and Mrs. Ira Wiggins, and Mr. Maurice Witten.—BARBARA JOE HOSHIZAKI, *565 N. Westmoreland, Los Angeles, Calif.*

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ERRATA

Page 11, line 2: For "*oneideuse*," read "*oneidense*."
Page 30, line 2 from bottom: Delete quotation marks.
Page 30, line 15: For "Wein," read "Wien."
Page 33, line 1: For "ramoissimum," read "ramosissimum."
Page 36, line 9: For "*Kuhn*," read "Kuhn."
Page 41, line 3 from bottom: For "OPHIPOPOGONOIDES," read "OPHIOPOGONOIDES."
Page 56, line 2 from bottom: For "please," read "pleased."
Page 73, line 5: For "*A.* × *curtissii*," read "*Asplenium* × *curtissii*."
Page 73, line 6: for "*A. abscissum*," read "*Asplenium abscissum*."
Page 73, line 8: For "*A.* × *trudellii*," read "*Asplenium* × *trudellii*."
Page 102, column 2, line 5: for "farnosa," read "farinosa."
Page 104, column 1, line 9: For "Polydactala," read "Polydactyla."
Page 104, column 1, line 5 from bottom: For "Polydactala," read "Polydactyla."
Page 106, colume 2, line 1: Delete "NyKs."
Page 107, column 2, line 12: For "Pulcherimum," read "Pulcherrimum."
Page 110, line 32: For "Maxon," read "(Underw. & Maxon) Copel."
Page 120, line 8: For "*echniospora*," read "*echinospora*."
Page 120, line 11 from bottom: For "Novia," read "Nova."
Page 124, line 12: For "*E. hiemale* var. *schleicheri*," read "I. E. × SCHAFFNERI."

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1. Authors of papers submitted to the *American Fern Journal* should consult the *Style Manual for Biological Journals* (1960) and be guided by its examples.

2. The "name-and-year" system for bibliographic references will, except in exceptional cases, be used. (See Literature Cited below for an example).

3. Authors are encouraged to use the journal abbreviations set forth by Schwarten and Rickett (1958, 1961).

4. Abbreviations of names of herbaria will be those listed by Lanjouw and Stafleu (1959).

5. Reports of chromosome numbers will not be accepted unless documented.

6. The use of footnotes and tabular matter should be kept to a minimum.

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Literature Cited

American Institute of Biological Sciences, Committee on Form and Style of the Conference of Biological Editors. 1960. Style Manual for Biological Journals. American Institute of Biological Sciences. Washington, D. C. 100 p.

Lanjouw, J., and F. A. Stafleu. 1959. The Herbaria of the World. Index Herbariorum, Regnum Veg. **15**: 1-249.

Schwarten, L., and H. W. Ricket. 1958. Abbreviations of Titles of Serials Cited by Botanists. Bull. Torrey Club **85**: 277-300; 1961. Supplement I. Ibid. **88**: 1-10.

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IRA L. WIGGINS

C. V. MORTON ROLLA M. TRYON

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American Fern Journal

Vol. 53 January-March, 1963 No. 1

A Biosystematic Survey of United States Ferns—Preliminary Abstract[1]

W. H. Wagner, Jr.[2]

As has been shown in recent years, the disciplines of cytology and genetics have supplied rich sources of comparative data and interpretation for the understanding of fern relationships and taxonomy. The study of species problems utilizing information from population analyses, statistics, uniform cultures, hybridization, chromosomes, and other such techniques is usually referred to as "biosystematics," a perhaps unfortunate term, but one which has become rather firmly entrenched in biology. The biosystematics of the ferns is a fairly new field, but it has already yielded a tremendous new body of information.

In connection with a general research project on the phylogenetic characters and classification of the ferns (National Science Foundation Grant G-10846) over the past several years, many new data have been accumulated on the ferns of the United States. The time is not ripe, however, to publish the details of these new observations. I feel that it is desirable, nevertheless, to present an outline of the results so far, in order that others may use the information or know that such data exist. Because

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[2] I wish to acknowledge the advice and aid of Edgar T. Wherry and Conrad V. Morton; the assistance of Virginia M. Morzenti, James P. Gillespie, and Katherine Lim Chen; and the contributions of living specimens and field help by many people mentioned in this article. The research was made possible by a National Science Foundation Grant.

of various "loose ends" that still need study, the detailed report of this work will not be completed for some months yet. The following enumeration is not complete, but will contain some of the more important discoveries.

In the Ophioglossaceae of the United States, the most problematic species are the members of the evergreen grapefern group, *Botrychium* Subg. *Sceptridium*. Population studies in connection with this present project have revealed useful new data on root diameters and dwarfing of plants in extreme environments (Wagner, 1961, 1962b). All except one of the species of this group so far examined from the United States have $n = 45$ chromosomes (*B. schaffneri* of Mexico supplied by J. T. Mickel showed approximately this number also). A conspicuous exception is *Botrychium alabamense*, a southeastern United States species with $n = 90$. In three taxa of evergreen grapeferns of the southeast — *B. alabamense*, *B. biternatum* (syn. *B. tennifolium*), and *B. lunarioides* (syn. "*B. biternatum*" by misapplication of name), — there are two major problems (a) whether *B. biternatum* is a species distinct from the wide-ranging *B. dissectum*, and (b) whether *B. alabamense* is distinct from *B. lunarioides*. Both of the latter problems have now been investigated in field work in Maryland (Wagner and Rawlings, 1962), Indiana (with the help of Dale M. Smith), Kentucky (with R. H. Wiley), South Carolina (with John L. Frierson), Tennessee (with Elsie Quarterman), and Alabama (with Paul Biebel and G. S. Jones), as well as by herbarium and laboratory studies. The new evidence especially from mass collections of local populations, indicates that *B. dissectum* and *B. biternatum* are distinct, though closely allied, species which grow sympatrically nearly throughout the area.

Botrychium lunarioides is the most peculiar species in the group. It is rare and little-collected, but I have now seen it in three localities in South Carolina and Alabama. *Botrychium alabamense* is a valid species, distinct from *B. lunarioides* in a number of characteristics. However, as I reported at the 1962 meetings of the Association of Southeastern Biologists (Wagner,

1962c), *B. alabamense* is intermediate in a number of respects between *B. lunarioides* and *B. biternatum*. All of the comparative evidence supports the idea that *B. alabamense* originated as a cross of *B. lunarioides*, both of which have $n = 45$ chromosomes. The chromosome complement of *B. alabamense* suggests that it is an allopolyploid, with one set of chromosomes from *B. biternatum* and one from *B. lunarioides*. The present abundance and range of *B. alabamense* exceeds that of *B. lunarioides;* the former has recently been recorded from as far north as Virginia by A. B. Massey.

The statement by Gopal-Ayengar (1957) that American reports of $n = 92$ chromosomes in *Botrychium virginianum* are due to precocious separation of the paired bivalents and that the actual number is $n = 90$ has not been confirmed by studies of collections from new localities in Michigan and South Carolina, which show clearly $n = 92$ pairs. The "rattlesnake fern," *B. virginianum*, is thus unique among all of our known species of *Botrychium* in having a chromosome number based, apparently, on $x = 46$ rather than 45.

In the Schizaeaceae, a family poorly represented in the United States, the climbing-fern of the eastern area, *Lygodium palmatum*, has proved to have $n = 30$ chromosomes, as determined from materials supplied by Katherine E. Boydston. This number, as well as $n = 29$, has been known previously in the genus. The most interesting results in this family concern the species of the genus *Schizaea*. The curly-grass fern, *S. pusilla*, a famous plant of the New Jersey Pine Barrens, was found to have $n = 103$, a most unusual number, especially in view of Chiarugi's (1960) suggestion that the x or base number is 11. The only earlier report for the genus was that of Lovis of $n = 77$ in *S. asperula*, a species of New Zealand (cited by Chiarugi). John A. Small supplied the *S. pusilla* specimens.

In field work in the state of Hawaii I was fortunate, in company with John A. Rattenbury and Richard A. White, to find plants of *S. robusta*, a fern of the rain-forest and mountain bogs which bears some resemblance to *S. pusilla*, but differs in its

larger size and monomorphic leaves. The chromosome number of the Hawaiian species proved, however, to be $n = 96$, making still less likely Chiarugi's proposed $x = 11$ as the base number for the genus.

The Pteridaceae produced a number of interesting observations, especially those in connection with *Sphenomeris*. There are only two species in the United States—*S. clavata* of Florida, and *S. chinensis* (syn. *S. chusana*) of Hawaii. The chromosomes of *S. clavata* from material obtained by C. E. Delchamps turned out to be extremely small. Their number, as judged by two clear figures, is $n = 39$. I was able to obtain Hawaiian material of the other species, *S. chinensis*, in the field; and the best figures showed $n = 47$, the same number that I found in Hawaiian *Lindsaea macraeana*. On the basis of chromosome numbers, then, one would conclude that the Hawaiian species is more closely related to its associated *Lindsaea* than it is to the Florida plant that presumably belongs in the same genus. I am informed by Dr. K. U. Kramer of Utrecht, Netherlands, that he plans to look into the generic constitution of *Sphenomeris*.

Deviations from the basic or "*x*" numbers of chromosomes in fern genera are relatively rare. The example given in the foregoing paragraph shows such strong deviation that one may question whether the species involved truly belong to the same genera. It is now well established that certain genera among the cheilanthoid ferns (*Adiantum*, *Cheilanthes*, *et alia*) have two base numbers, $x = 29$ and 30, but the latter has been more common in our observations. *Cheilanthes lanosa*, *C. siliquosa*, *Cryptogramma stelleri* all have $n = 30$. South of the border, *Hemionitis palmata* has $n = 30$ and *Llavea cordifolia* has $n = 29$. Two Florida species, *Adiantum capillus-veneris* (from near Tallahassee) and *Trismeria trifoliata* (near Miami) are both apparently tetraploids, with $n = 60$.

In connection with this work I have published observations (Wagner 1962a) on the sterile California plant intermediate between *Adiantum jordanii* and *A. pedatum*, which show that the putative hybrid has 59 unpaired chromosomes. As we know now

that Californian *A. pedatum* possesses $n = 29$ chromosomes, we may predict that *A. jordanii* will have $n = 30$ (as does *A. tenerum* of Florida). It should be mentioned that studies of the dwarf maidenhair fern, *Adiantum pedatum* "miniature," which is now becoming so popular in horticulture, show its chromosome complement to be indistinguishable from that of the typical form of the species.

The numbers $x = 29$ and 30 are so well established for the cheilanthoid ferns, that it was with considerable surprise that we determined $n = 27$ in *Notholaena dealbata* collected in Kansas City, Missouri. The only previous deviation from basic numbers of which I have seen reports is that for *Cheilanthes tenuifolia* of the Old World tropics, with $n = 28$.

Even more surprising was the chromosome situation in the odd *Pteris lidgatii* that grows in the mountain rainforest of Hawaii. The spores of this species are the largest in the genus, suggesting that the chromosome number would be that of a high polyploid. The chromosome number, on the contrary, was revealed to be $n = 58$, a number found in species with much smaller spores. *Pteris lidgatii* I expected to be octoploid at least, but the actual number is only tetraploid. The same number is found in *Pteris vittata* and *P. tripartita* materials from Florida supplied by C. E. Delchamps. A plant intermediate between *P. vittata* and *P. longifolia* from Miami shows irregular pairing of ca. 116 chromosomes, suggesting that the true *P. longifolia* of that area will prove to have $n = 58$ chromosomes also.

A number of intriguing problems have shown up in connection with the Aspidiaceae. I have come to the conclusion that the seemingly "casual" hybrids that have been reported in the oak-ferns, *Gymnocarpium*, may prove to be much more significant than previously supposed. Plants that conform more or less to the material I found several years ago near Marquette, Michigan, that were described by Mrs. Root in this Journal (1961), are now turning up over an expectedly wide range—from Alaska to Pennsylvania. Edward G. Voss has discovered the plant growing abundantly in a locality on the north side of Lake Superior.

The plant which Rolla M. Tryon described as "forma *glandulosa*" of the common oak-fern belongs to the taxon in question. Most interesting of all is the fact that the so-called *Gymnocarpium robertianum* which grows near Altoona, Pennsylvania, seems also to belong to the intermediate taxon.

A few chromosome observations on plants from the last locality supplied by Edgar T. Wherry revealed both bivalents and univalents, which, totaled up, gave approximately 120 chromosomes. If the intermediate plant is truly the hybrid of *G. dryopteris* and *G. robertianum* then it ought to have ca. 160 chromosomes, because the parents both have $n =$ ca. 80, as found not only in Michigan materials but in Europe as well. Currently I am working on this problem from the standpoints of distribution of the intermediate, improving staining of its chromosomes so that they may be more precisely evaluated, and, above all, the mode of reproduction in the intermediate, which may actually be apogamous and incapable of reproducing itself by spores.

The numerous cytogenetic studies of American woodferns, *Dryopteris,* by Stanley Walker have tended not only to confirm the various concepts of inter-relationships proposed by E. T. Wherry, but in some cases to add new ones. An opportunity to study living plants in the preserved area of the Huron Mountain Club property on the south shore of Lake Superior in a collaboration by the author and Dale J. Hagenah revealed a number of interesting interspecific hybrids. The most controversial results of this investigation involved the "Lake Superior *Dryopteris dilatata,*" a representative of the very difficult "*D. dilatata*" group that possesses the diploid chromosome number of $n = 41$. Our comparative studies led us to the conclusion that "Lake Superior *D. dilatata*" is a species different from the eastern American *D. campyloptera*, and it also does not match in its various characters the materials named "*D. dilatata*" that grow in the region from northern California to Vancouver. Our single hybrid of "Lake Superior *D. dilatata*" with *D. intermedia* showed no pairing or minimal pairing. (The actual numbers of ten plates were: 4 plates had 82 singles; 2 plates had 78 singles and

2 pairs; 3 plates had 74 singles and 4 pairs; and 1 plate had ca. 69 singles plus 6 pairs. From the morphology of the hybrid (of which an offset still is growing in Birmingham, Michigan), we suggested that the eastern *Dryopteris campyloptera* may be the amphidiploid form of the hybrid, that is, a species derived by doubling of chromosomes from a sterile hybrid of "*D. dilatata*" and *D. intermedia*.

In a recent critique, D. M. Britton argues that "Lake Superior *D. dilatata*" is the same species as *D. campyloptera*, and that *D. campyloptera* may be merely the autopolyploid of *D. dilatata*. His suggestion, however, seems to ignore the numerous differences between the "Lake Superior *D. dilatata*" and "*D. campyloptera*, as enumerated in the key presented by Hagenah and myself (1962). In addition, later studies of mixed populations of true *D. campyloptera* growing with *D. intermedia* at Mountain Lake, in Giles County, Va., during the summer of 1962, revealed some hybrids. If *D. campyloptera* ($n = 82$) is actually "*D. dilatata*" ($n = 41$) $\times$ *D. intermedia* ($n = 41$), as Hagenah and I have suggested, then it should be possible on the basis of past studies in this genus (cf. Manton and Walker, 1954) to predict the chromosome pairing behavior of the backcross. The single set of chromosomes from *D. intermedia* should pair with one of the two sets from *D. campyloptera*, and there should be, accordingly, 41 pairs and 41 singles. That is exactly what we found. Not only did we find this homology of *D. intermedia* with one of the sets of chromosomes in *D. campyloptera*, but we discovered that *D. campyloptera* itself is a vastly more variable taxon than has apparently been previously realized. Accordingly, it is planned to write a detailed report on the Mountain Lake studies in the near future.

A similar process of origin may now be proposed for the western holly-fern known as *Polystichum californicum*. On the evidence accumulated thus far, this species exists in two forms, one sterile and one fertile. The plant is an intermediate between *P. dudleyi* and *P. munitum* and is probably their natural hybrid. The original, diploid condition is sterile, but when the chromo-

some number is doubled it becomes fertile. A large collection of fronds sent by Ira L. Wiggins and collected originally by Donald L. Branscomb and Harry Roberts in various localities in California reveals that many of them are sterile (i.e., have abortive spores) and others are entirely fertile (with normal spores). I have now studied cytologically all but two of the possible members of the complex: *Polystichum munitum*, with n = 41 pairs; *P. californicum*, with $2n = 82$ chromosomes and irregular pairing; *P. californicum* × *munitum*, with roughly 41 pairs and 41 singles at meiosis; and *P. californicum* × *dudleyi*, similar to the last. I still need to examine typical *P. dudleyi* (predicted, $n = 41$ pairs) and the fertile form of *P. californicum* (predicted. $n = 82$ pairs). I shall appreciate living materials of either of the latter species to grow and study at the University of Michigan Botanical Gardens. I am especially indebted to Mr. Branscomb for taking me to a locality where all of these forms exist. Unfortunately, the two taxa that still remain to be examined for their chromosome numbers were found, but for some reason the plants died in transit. Present observations on herbarium materials indicate that the situation in western American Polysticha in general is a complicated one. *Polystichum dudleyi* is so similar to the Hawaiian *P. haleakalense* that it may be the same species. There is an undescribed, large-spored species of holly-fern in Hawaii that greatly needs study. In Oregon and Washington several species overlap in range, and a number of collections suggest that they may hybridize with each other. The plant known as *Polystichum munitum* var. *imbricans* needs critical study: it may be a wholly distinct species from typical *P. munitum*, with which it may hybridize and thus seem to intergrade.

Thanks especially to C. E. Delchamps and others in Florida, including E. S. Ford and R. K. Godfrey, I have been able to examine a number of thelypteroid ferns cytologically. The results of these observations lead me to believe that we have in these ferns of the United States one of the most complex biosystematic situations to be found anywhere. This assemblage of plants will require exhaustive examination before any rational taxonomy can

be worked out. The very distinct elements like *Thelypteris reptans* ($n = 72$), *T. sclerophylla* ($n = 72$), and *Meniscium serratum* ($n = 36$) pose no questions. It is the complex of species that include plants identified as *T. augescens, T. normalis, T. patens, T. serra,* and *T. versicolor* that are confusing. I obtain counts of 36 pairs, 72 pairs, or 36 singles and 36 pairs in these plants seemingly without pattern, at this stage of understanding at least. I therefore conclude that the rate of hybridization must be very high among these plants, and that vegetative reproduction by rhizomes must play an important role in establishing the large populations that are frequently found to comprise obviously sterile plants.

In at least one case, culturing plants uniformly at the University of Michigan Botanical Gardens has revealed that growth form induced by ecology has misled taxonomists. Dr. Delchamps kindly sent me a small plant identified as *T. saxatilis,* which E. P. St. John had described as a species distinct from *T. normalis* on the basis of its small size and occurrence on cliffs, rocky slopes, and other exposed places. In just a few months, however, this plant grew to larger size in the more luxuriant conditions of the greenhouse, and matched exactly previous materials received as *T. normalis*, with $n = 36$ in both entities.

The "Massachusetts fern," *Thelypteris simulata,* is intermediate in various ways between the "Marsh fern" *T. palustris* ($n = 35$) and "New York fern," *T. noveboracensis* ($n = 27$). If it were the recent allopolyploid of the latter two species, *T. simulata* might be expected to have $n = 62$ chromosomes. Its actual number is $n = 64$, as determined in a number of preparations from Maryland supplied by Neil Hotchkiss. (The material from Wisconsin provided by Thomas Hartley could not be exactly determined, but the number is very close or the same). Thus, if *T. simulata* did actually originate by hybridization of the two species between which it is an intermediate, that event may have occurred long ago, and chromosomal evolution of the fern has made two aneuploid changes, viz. $n = 62$ to 63 to 64. Another

possibility is that *T. noveboracensis* itself once had a higher number.

It was satisfying to find that the Florida plant, *Ctenitis submarginalis*, which superficially resembles a thelypteroid fern (and was actually placed in *Thelypteris* by Small in 1938) has the chromosome number of $n = 41$ rather than the $x = 36$ so characteristic of truly thelypteroid ferns in Florida (the only *Thelypteris* from Florida studied so far that has other than $x = 36$ is *T. palustris*, with $n = 35$). *Ctenitis ampla*, a more "normal" member of its genus, has also $n = 41$. The latter number seems to be characteristic of all the more strictly aspidioid ferns. *Dryopteris patula* and *Phanerophlebia umbonata* from Dr. Mickel's Mexican collections have meiotic figures which are practically indistinguishable from those of diploid *Ctenitis*. The genus *Tectaria* has a closely related number, $n = 40$, in three species examined (Hawaiian *T. gaudichaudii*, Mexican *T. trifoliata*, and Floridian *T. minima*). One polyploid, *Tectaria heracleifolia* from Florida is a tetraploid, $n = 80$.

The investigations in the Aspleniaceae of the United States have exposed some extremely interesting biosystematic situations. The basic number of the family as a whole is $x = 36$. *Asplenium pumilum* of Florida was found to have $n = 36$, *A. serratum* from the same state has $n = 72$, *A. fragile* from Hawaii has $n = 72$, and *A. acuminatum* and *A. lobulatum* from the latter state showed $n = 144$ or near that number. The spleenworts thus include a number of polyploid levels. Some of the species are also apogamous, the life-cycle involving peculiarities of spore production that lead to the gametophyte and the sporophyte having the same choromosome number. The plants known as *A. unilaterale* in Hawaii seem to include two species, one of them a sexual diploid ($n = 36$), the other an apogamous polyploid (possibly tetraploid). They may be distinguished in herbarium specimens by comparing the contents of their spore-cases.

The familiar limestone spleenwort, *Asplenium resiliens*, is an apogamous triploid fern with 108 chromosomes and no alternation of chromosome numbers between the two generations. Miss

Virginia M. Morzenti made studies in connection with the present project of the similar plant, *A. heterochroum,* of Florida, basing her work on materials sent by Thomas Darling, Jr., and E. S. Ford. The results of these researches show clearly that there are three different ferns included under the name *A. heterochroum* in herbaria—(a) a sexual plant with 4x chromosomes ($n = 72$); (b) a sexual plant with 6x chromosomes ($n = 108$); and an apogamous spleenwort with 180 chromosomes. The most interesting plant is the latter, a pentaploid apogamous fern (in which both "$2n$" and "n" = 180) which is morphologically intermediate between *A. heterochroum* and *A. resiliens.* It represents an undescribed species, heretofore unrecognized in North America, and its existence was first reported to the Association of Southeastern Biologists in April, 1962, by Miss Morzenti and the writer. A trip made later by the author in company with Harry Ahles of the University of North Carolina to a locality in Jones Co., N.C., revealed that plants originally discovered by Albert E. Radford and identified as *A. resiliens* are actually the new species. Similar specimens are known in herbaria from the Santee Canal region of South Carolina, growing, as were those of Dr. Radford, on marly limestone outcrops. The plant should be sought along the Coastal Plain of the southeastern United States, wherever marl outcrops occur. The intermediate plant is most common in Florida, and I have now, in company with R. K. Godfrey and R. T. Mitchell, seen it growing at Aspalaga, on the Liberty-Gadsden Co. line, and at Florida Caverns Park, in Jackson Co. Also, in company with E. S. Ford, I found the plant along the old river bed of the Santa Fe River, in Columbia Co. This apparent cross between *A. heterochroum* and *A. resiliens* probably arose through the fertilization at some time in the past of a gametophyte of *A. heterochroum* by sperms from the apogamous gametophyte of *A. resiliens.* There is some evidence from herbarium specimens that the new fern may backcross with *A. heterochroum.*

According to my field and herbarium observations, the true *A. resiliens* is a rare plant in Florida. I have seen it only at

Aspalaga. Most of the plants identified as this species from Florida are actually the new species.

I am indebted to Thomas Darling, Jr., for suggesting that I investigate the Florida spleenworts of the *Asplenium abscissum-cristatum-dentatum-verecundum* group. Thanks to Mr. Darling, and to C. E. Delchamps, I have been able to study growing plants which they sent from Florida to the University of Michigan Botanical Gardens. *Asplenium biscayneanum* from southern Florida proved to be intermediate morphologically between *A. dentatum* and *A. verecundum,* as has been suggested by previous authors. The precise number of chromosomes in *A. biscayneanum* could not be determined but it is apparently around 180. The behavior of the chromosomes at meiosis is extremely irregular; and this plant is almost undoubtedly the hybrid of *A. dentatum* (with 108) and *A. verecundum* (with 72 chromosomes). It probably reproduces vegetatively by some cryptic means (see below, in connection with *A. plenum,* for a possible mechanism).

Asplenium curtissii of northern Florida proves to be intermediate between *A. abscissum* ($n = 36$) and *A. verecundum* ($n = 72$). The hybrid *A. curtissii* resembles more the parent with the larger number of chromosomes than the other. The hybrid chromosomes number 108, with irregular but minimal pairing (from one to 15 pairs). It, like *A. biscayneanum,* tends to form colonies of plants on mossy limestone, and may like it have a hidden method of vegetative reproduction. The plant was so sparse in the localities I visited in the spring of 1962 that I was hesitant to make collections.

The most unusual member of this group is *Asplenium plenum.* Although known previously only from a locality near Lecanto, Florida, where the type material was gathered, it was recently re-discovered by Thomas Darling and E. S. Ford at Indian Field Ledges, with the plants on one rock occurring in the hundreds. I found that living plants from this site are allotetraploid, with $n = 72$ and only about five to ten disjoined pairs in most figures. This meant two diploid species or two tetraploid species must have participated in its origin, if it is a hybrid. At the diploid

level, one of the obvious candidates was *A. abscissum,* which grows with *A. plenum* constantly and has $n = 36$ chromosomes. Because of the frond dissection of *A. plenum,* which is simpler than in *A. curtissii,* and also the symmetrical chromosome number of *A. plenum, A. verecundum* was not likely to be the other parent. I, therefore, proposed that *A. cristatum* ($n = 36$) was the probable other parent, even though at the time it was not yet known from Indian Field Ledges. The most remarkable cytological feature that we found in connection with our study of *A. plenum* was the fact that in spite of its doubled chromosome number, its spores were abortive and they failed to germinate in culture, another point in favor of its interpretation as a hybrid.

A field trip in company with E. S. Ford and Mildred Griffith to the Indian Field locality, north of Wahoo in Sumter County, revealed *A. plenum* in great abundance on one large rock and some scattered plants elsewhere. We did find the predicted *A. cristatum* at the locality, but there was only one plant. But we were unable to find gametophytes of *A. plenum,* even though all indications were that the fern was reproducing here in natural conditions by normal sexual alternation of generations, the young sporophytes that we observed being of exactly the same size that one expects from gametophytes of other species of spleenworts growing in the moss. Later studies in my laboratory of living material of mosses containing the young sporophytes of *A. plenum* showed conclusively what was taking place. The entire colony is apparently a single clone—reproducing, in this hybrid, by root proliferations, the roots extremely small and inconspicuous; the young sporophytes are easily broken off unless great care is taken in dissecting them.

The above work on *A.* × *biscayneanum, A.* × *curtissii,* and *A.* × *plenum* was reported at the session of the American Fern Society in connection with the American Institute of Biological Sciences meetings in August, 1962; and further work is still to be done before the final detailed report.

Among the more northerly spleenwort species and hybrids,

there are a few new observations. *Asplenium* × *wherryi* (*A. bradleyi* × *montanum*) has been shown to have ca. 36 pairs and 36 univalents in materials collected in Giles County, Virginia, where it was found by Carl S. Keener. Such pairing behavior was predicted on the hypothesis that *A. bradleyi* itself is the amphidiploid hybrid of *A. montanum* and *A. platyneuron*, and this is the first cytogenetic observation yet made on a direct backcross. Also, our first cytogenetic test of homology of chromosomes between *Asplenium ebenoides* (*A. platyneuron* × *rhizophyllum*) and *A. pinnatifidum* (the putative allopolyploid of *A. montanum* and *rhizophyllum*) was made possible by Kathryn E. Boydston, who found the hybrid in her cultures at Fernwood, Niles, Michigan. The cross showed that there is indeed a set of chromosomes of *A. pinnatifidum* that is homologous with one set in *A. ebenoides* (Wagner and Boydston, 1961). Mrs. Boydston also had the good fortune to produce a hybrid of *Asplenium* (*Camptosorus*) *rhizophyllum* and *Phyllitis scolopendrium* var. *americanum*. Unfortunately, however, the plant died before we could make detailed chromosome observations, but the few figures that we did see showed a highly irregular situation in meiosis. Fronds of this hybrid are deposited in the Herbarium of the University of Michigan, along with vouchers of all the other records cited here. We have currently under observation at our Gardens two plants of one of the rarest North American hybrid spleenworts—*A.* × *clermontae* (*A. ruta-muraria* × *trichomanes*) the second North American find, on mossy limestone rocks in Clifton Gorge, Greene County, Ohio, where it was growing with *A. ruta-muraria* f. *ohionis* and *A. trichomanes*. I am indebted to Floyd Bartley who led me to the locality and helped me make studies of the spleenworts of Clifton Gorge.

In the Polypodiaceae, a number of observations have been made, including the examination of certain Florida plants referred to *Polypodium pectinatum*. There are clearly at least three members of this group in Florida, one of which is either a sterile or apogamous fern that occurs on tree-trunks and rocks, and resembles a hybrid of *P. pectinatum* and *P. plumula*. My

materials of this plant, and other members of the Polypodiaceae gathered in this project, have been turned over to A. Murray Evans, who is making special studies of these plants in connection with his doctoral thesis.

The basic number in the Polypodiaceae is evidently $x = 37$. Mexican *Polypodium polypodioides* and Californian *P. scouleri* show exactly this number. However, tetraploids have turned up, such as *P. pectinatum*, *Campyloneuron angustifolium*, and *C. phyllitidis* (the last from Florida), as well as the very strange Hawaiian fern known as "Peahi," *Microsorium spectrum*, all with $n = 74$. United States representatives of the rain-forest ferns now generally referred to a family separate from Polypodiaceae s.s., the Grammitidaceae, occur in the state of Hawaii. It has been found that *Grammitis tenella*, which is endemic there, has $n = 37$. Also, several species of grammitid ferns usually placed in the endemic Hawaiian genus *Amphoradenium* (syn., *Adenophorus*) proved to have the same number.

In the polypodioid-grammitoid ferns of the United States, it is possible that the only species that deviates from x = 37 will be *Pleopeltis thunbergiana*. Unexpectedly, our single collection of this Hawaiian fern, which seems to be entirely fertile, showed $n = 51$. Further studies of this unexpected situation are contemplated.

The total number of new cytogeographical records to be included in the forthcoming report will probably exceed 150. The above abstract contains some of the more unusual or interesting records, but is not at all complete. I shall be glad to communicate answers to any questions that may arise to other persons working on similar problems. Also, I shall appreciate any living rhizomes of materials that pertain to this research that members of this Society are willing to contribute. Plants carefully uprooted and placed (without watering) in a plastic bag inside a firm cardboard box and airmailed to the address below will be planted immediately under ideal conditions; most of those that we have received in this way have developed nicely, becoming fertile and forming sori that could be studied cytologically.

It is hoped that this survey, when completed, will materially add to our knowledge of the biosystematics of the ferns of the United States.

LITERATURE CITED

BRITTON, DONALD M. 1962. *Dryopteris dilatata* (Hoffm.) A Gray in North America. Rhodora **64**: 207-211.

CHIARUGI, ALBERTO. 1960. Tavole cromosomiche delle Pteridophyta. Caryologia **13** (no. 1): 27-150.

GOPAL-AYENGAR, A. R. 1957. Origin and behavior of chiasmata in Botrychium. Proc. Ind. Sci. Congress **44**: 249.

MANTON, I. and S. WALKER. 1954. Induced apogamy in *Dryopteris dilatata* (Hoffm.) A Gray and *D. filix-mas* (L.) Schott emend. and its significance for the interpretation of the two species. Ann Bot. n. s. **18**: 377-383.

MORZENTI, VIRGINIA M. and W. H. WAGNER, JR. 1962. Southeastern American "blackstem spleenworts" of the *Asplenium heterochroum-resiliens* complex (Abstract). ASB Bull. (Assoc. Southeastern Biologists) **9**: 40-41.

ROOT, ELIZABETH EICHSTEDT. 1961. Hybrids in North American Gymnocarpiums. Amer. Fern Jour. **51**: 15-22.

SMALL, J. K. 1938. Ferns of the Southeastern States. Lancaster, Pa.

WAGNER, W. H., JR. 1961. Roots and the taxonomic differences between *Botrychium oneidense* and *B. dissectum*. Rhodora **63**: 163-175.

———. 1962a. Cytological observations on *Adiantum* × *tracyi* C. C. Hall. Madroño **16**: 158-161.

———. 1962b. Plant compactness and leaf production in *Botrychium multifidum* "ssp. *typicum*" and "forma *dentatum*." Amer. Fern Jour. **52**: 1-18.

———. 1962c. The endemic Botrychiums of the southeastern United States. (Abstract). ASB Bull. **9**: 40.

———. and Kathryn E. Boydston. 1961. A new hybrid showing homology between *Asplenium ebenoides* and *A. pinnatifidum*. Brittonia **12**: 286-289.

———. and D. J. Hagenah. 1962. *Dryopteris* in the Huron Mountain Area of Michigan. Brittonia **14**: 90-100.

———. and David E. Rawlings. 1962. A sampling of *Botrychium* Subg. *Sceptridium* in the vicinity of Leonardtown, St. Mary's Co., Md. Castanea **27**: 132-142.

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Woodwardia in Canada[1]

W. J. CODY

The genus *Woodwardia* is a group of coarse ferns with horizontal widely creeping or stout ascending rhizomes; stipes fascicled if rhizome ascending, remote if rhizome creeping; fronds similar or dimorphic, pinnatifid or bipinnatifid; veins anastomosing to form costal or costular areolae, then free to the margin or forming additional areolae; sori linear or oblong, parallel to the midveins, borne along the veinlets which form the outer side of the first row of areolae; indusium persistent, opening on the side adjacent to the midrib. It is found in temperate and tropical regions in the Northern Hemisphere.

In America north of the Mexican border, four species of *Woodwardia* are known to occur. Three are native species which range into southern Canada. The fourth, *W. radicans*, an Old World species, has, according to Broun (1938), been introduced into cultivation in Florida where it has escaped to swamps and hammocks. Since our native *W. virginica* and *W. fimbriata* were both at one time included in *W. radicans*, this species is treated in the key below:

Fronds 2.5 to 4.5 (6) dm. high, strongly dimorphic, pinnatifid, the fertile with narrowly linear almost distinct divisions 5 to 8 cm. long, firm; sterile fronds elliptic to lanceolate, with copiously anastomosing veins forming many areolae, membranous ..... 1. *W. areolata*

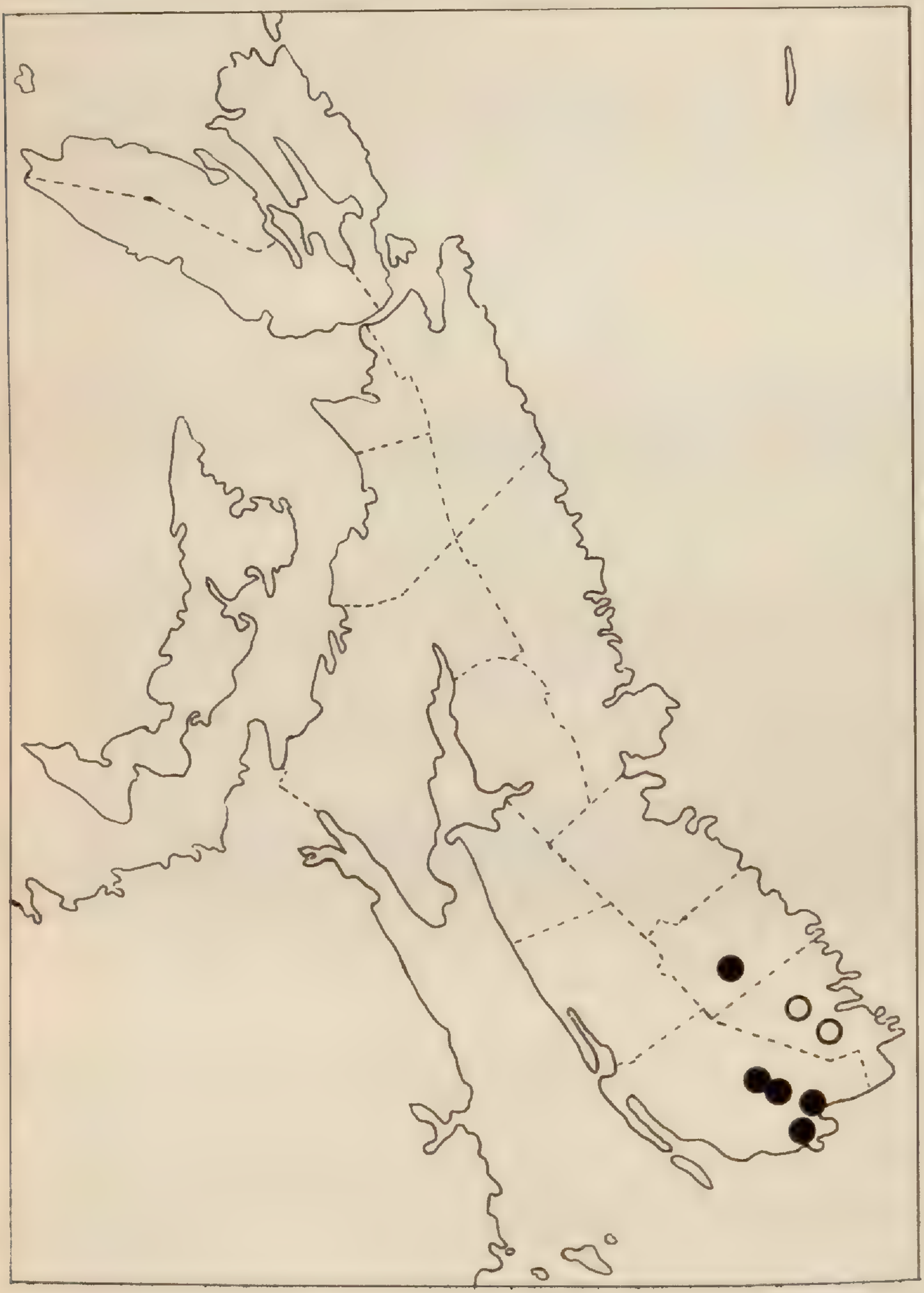
Fronds 7 to 20 dm. high, the sterile and fertile similar or nearly so, pinnate-pinnatifid; veins forming one or at most one and three-quarter rows of areolae:

Fronds 7 to 13 dm. high; pinnules 0.6 to 1.5 cm. long; sori parallel to the midveins of both the pinnae and pinnules, usually confluent when mature ..... 2. *W. virginica*

Fronds 10 to 20 dm. high; pinnules 2 to 6 cm. long; sori parallel to the midvein of the pinnules and only rarely to the midvein of the pinnae, usually separate at maturity:

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[1]Contribution No. 155 from the Plant Research Institute, Canada Department of Agriculture, Ottawa.



Canadian Distribution of Woodwardia areolata

(Solid Circle, Specimens Seen; Open Circle, Literature Record)

Rachis not proliferous; lower surface of pinnules often glandular-punctate; venation on lower surface often obscure; second row of areolae extending less than half the length of the pinnule; teeth of pinnules 0.3 to 0.6 mm. long ..... 3. *W. fimbriata*

Rachis usually proliferous with a chaffy bud near the apex of the frond; lower surface of pinnules not glandular-punctate; venation on lower surface distinct; second row of areolae extending more than half the length of the pinnule; teeth of pinnules about 0.1 to 0.2 mm. long (Not in Canada) ..... 4. *W. radicans*

1. WOODWARDIA AREOLATA (L.) Moore
Lorinseria areolata (L.) Presl

This is an Atlantic coastal plain species. I have seen specimens or reports in the literature from the following states: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, New Jersey, Maryland, Delaware, District of Columbia, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Louisiana, Mississippi, Tennessee, Arkansas, Kentucky, Ohio, Missouri, Oklahoma, Texas, and Michigan. *Woodwardia areolata* ranges over a somewhat smaller area than *W. virginica*. The only Canadian province in which it occurs is Nova Scotia.

According to Wherry (1921) *W. areolata* requires a much more acid habitat than the following species. He designates the habitat requirement as mediacid.

Roland (1947) knew this species only from Yarmouth and Shelburne counties in Nova Scotia. His comments were "Local in the Tusket Valley; abundant and well-developed along the upper limits of the Clyde and Roseway river systems where it is found in swamps, wet woods, and at the margins of bogs." Fernald (1921) wrote that he had observed it and *W. virginica* growing among cobblestones on the beach of Gavelton Lake which is part of the Tusket River system. *Woodwardia areolata* has since been collected in Queens County, but so far as I am aware has gone unrecorded: shaded bog, Shelburne River at head of Sand Lake, *E. C. Smith et al. 230* (DAO ex ACAD), and river edge, Shelburne River near Lake Rossignol, *E. C. Smith et al. 1335* (DAO ex ACAD). A map of the known distribution in Nova Scotia is given in Plate 1.

2. WOODWARDIA VIRGINICA (L.) J. E. Smith
Anchistea virginica (L.) Presl

Woodwardia virginica is another Atlantic coastal plain species which finds its way sporadically inland as far west as northwestern Illinois. I have seen specimens or reports in the literature from the following states: Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, Pennsylvania, New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Louisiana, Arkansas, Texas, Ohio, Michigan, Indiana and Illinois. I would have expected it to occur in the state of Mississippi also, but I have been unable to find any record of it having been found there.[1] In Canada, *W. virginica* is known from the following provinces: Nova Scotia, Prince Edward Island, New Brunswick, Quebec, and Ontario. Beyond the mainland of North America it is known from Bermuda, where Britton (1918) records it as frequent in the larger fresh-water marshes.

Roland (1947) gave a map of the distribution in Nova Scotia and New Brunswick. It shows the occurrence of the plant in Pictou, Hants, Kings, Annapolis, Digby, Yarmouth, Shelburne, Queens, Lunenburg, and Halifax counties. More recently Erskine (1951) has added it to the flora of Cape Breton Island, Nova Scotia, on the basis of specimens from West Lake Ainslie in Inverness County. Another county in Cape Breton Island can now be included in the distribution: Cape Breton County, Hillside, Mira, abundant in swamp, *G. C. Warren s. n.*, June 25, 1952; Aug. 1952 (DAO ex ACAD).

Roland (1941) stated that *W. virginica* was reported from Prince Edward Island. Erskine (1951) confirmed this record on the basis of a specimen collected in Queens County, by Smallwood in 1903. Erskine (1961) has added two other records, one from Queens County, and one from Kings County (DAO).

The record of *W. virginica* in New Brunswick is half a dot on the left margin of the distribution map in Roland (1947).

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[1] It does occur, although rarely, in Mississippi: Mississippi City, Harrison Co., Sept. 14, 1885, *Donnell Smith* (US); Ocean Springs, Jackson Co., Aug. 3, 1889, *S. M. Tracy* (US). [C.V.M.]

In Quebec *W. virginica* is known from the following counties: Berthier, Chambly, Chatauguay, Huntingdon, Iberville, Missisquoi, Napierville, Terrebonne, Yamaska, and Papineau. The Papineau County site [at edge of bog, "Hopkin's Hole" ½ mile NW of Ramsay Lake, Gatineau Park, Masham Twp., *Gillett & Calder 10264*, 1 Sept. 1959 (DAO), *Cody & Van Rens 11202, 11203*, July 13, 1960 (DAO)] was discovered by participants in one of the excursions from Ottawa during the IXth International Botanical Congress.

In his *Flore Laurentienne*, Frère Marie-Victorin (1935) gave the distribution of *W. virginica* as "Régions d'Ottawa, du lac Saint-Pierre et du Richelieu." He also noted the species as "Très rare sur notre territoire." When preparing the Ferns of the Ottawa District (Cody, 1956), I did not find any specimens of this plant from that part of Quebec included in the area within a 30 mile radius of the city of Ottawa in the herbaria at Ottawa or at Montreal. Marie-Victorin's reference to "Région d'Ottawa" probably was based on Ontario collections from Mer Bleu just east of Ottawa. A record in Macoun (1890) "Near Gaspé Basin, Que. (Eden)," seems to be incorrect. No specimen has been found to substantiate it and the record has not been taken up by the students of that region, Fernald (1925) and Scoggan (1950).

In Ontario, *W. virginica* is known from Bruce, Carleton, Grenville, Hastings, Lennox and Addington, Middlesex, Northumberland, Peel, Renfrew, Russell, Simcoe, and Wentworth counties, and from the districts of Parry Sound and Muskoka. The northernmost collection is from Frank's Bay on Lake Nipissing (TRT). The northernmost locality along the Ottawa River is recorded by Brayshaw (1959) in his "Check List of the Vascular Plants of Chalk River District [Ontario]". Mr. Brayshaw has written that the specimen upon which this record is based is labelled only "P. F. E. S. [Petawawa Forest Experiment Station, Renfrew County, Chalk River, Ontario], July 28, 1937," with no collector's name. The Hastings County record is based on a specimen in the Herbarium of the National Museum of Canada (CAN) collected by J. Macoun in swamps and wet woods



Canadian Distribution of Woodwardia virginica
(Solid Circle, Specimens Seen; Open Circle, Literature Record)

in North Hastings County, on July 11, 1870. This specimen strangely is not recorded by Macoun (1890). Macoun wrote, ". . . Near Heck's Mills, 10 miles from Prescott, Augusta Township, Ont. (*Billings*)—very abundant five miles north of Colborne village, and common in marshes at west end of Gull Lake, Addington Co., Ont. (*Macoun*)—" There are no specimens in either of the Ottawa herbaria or at Queens University from any of these three localities, but there is an unmounted label in the *Woodwardia* folder at Queens University which reads "*Woodwardia virginica* Willd. Sphagnous swamp near Heck's Mills 10 miles from Prescott, 23d July 1860. Perfect specimens could not be obtained at this season [*Billings*]." All three sites were visited briefly during the summer of 1960, but *Woodwardia* was not located at any. Indeed the only fern which was common at either Gull Lake or north of Colborne Village was *Dryopteris thelypteris* var. *pubescens*. Other sites which are of interest because they are at the known limit of distribution are Georgian Bay Islands (exact locality unknown), Tobermory in Bruce County, and London in Middlesex County (all TRT).

Wherry (1921) stated that *W. virginica* thrives best in mediacid sphagnum swamps and bogs, but that it tolerates a decidedly lower degree of acidity than *W. areolata*, having been found in waters as low as minimacid reaction in glacial drift in Pennsylvania.

Roland (1947) reported that *W. virginica* is characteristic of swampy woods, boggy shores, swamps, and cobbly lake-shores from Yarmouth County, east to Halifax; scattered north to Pictou and Kings counties. Near the limits of range however, this species appears restricted to strongly acid bog habitats. The localities in southwestern Quebec, in the Ottawa District, and at Petawawa are boggy habitats related to the Ottawa Sea submergence and old channels of the Ottawa River. The progenitors of the plants in this part of Canada quite conceivably migrated here by way of Lake Champlain. A map of the Canadian distribution is given in Plate 2.

3. WOODWARDIA FIMBRIATA J. E. Smith in Rees
Woodwardia chamissoi Brack.
Woodwardia paradoxa Wright

In his excellent Index Broun (1938) gives the date of publication of *W. fimbriata* as 1918, an obvious *lapsus calami.* As pointed out by Alston (1933), Jackson (1896) gives the date of publication of Rees, *Cyclopaedia* 38 II Part 76, as 31 July 1818 although the number is dated 1819.

The North American species, *W. fimbriata,* and the Mexican and Central American species, *W. spinulosa,* were for many years included in the Old World *W. radicans.* The earliest name for the North American plant is *W. fimbriata* but this name was not brought to light until 1933 (Alston, 1933). Prior to 1933 the American species had been treated as one under *W. radicans* var. *americana* Hooker or *W. spinulosa* Mart. & Gal., but Maxon (1919) demonstrated the existence of two species in North and Central America: the southern *W. spinulosa* extending from Mexico to Guatemala and the northern *W. chamissoi* (*W. fimbriata*) ranging from California to British Columbia. Maxon (1949) described *W. martinezii,* from near Zacualtipan, Hidalgo, Mexico. Among other characters, *W. spinulosa* differs from *W. fimbriata* in having minute filiform brownish-fibrillose scales on the under side of the pinnules; the second row of areoles extends well beyond the middle of the pinnule; and the large resin glands found on the under surface of the pinnules of *W. fimbriata* are absent in *W. spinulosa.*

Another name, *W. paradoxa,* enters the picture. This was described by Wright (1907), based on specimens grown at Kew "from a small island off Vancouver Island." This name was placed in synonymy immediately by Underwood (1907).

Woodwardia fimbriata is reported by Maxon in Abrams (1923) as "Moist shady banks from near sea level to above 1500 meters altitude, Upper Sonoran and Transition Zones; western British Columbia to southern California and Arizona; also in northeastern Nevada." I have seen specimens or reports from the following states: Washington, Oregon, California, Arizona and

Nevada. Wiggins (1944) stated that Brandegee had reported *Woodwardia fimbriata* (as *W. radicans*) from La Grulla in northern Baja California, Mexico. Wiggins found this fern in abundance at several other localities in the Sierra San Pedro Martir in 1941 (personal communication).

In British Columbia it is known from Texada Island, from whence it was recorded as new to Canada by J. M. Macoun (1899) (specimens in CAN *sub W. radicans* var. *americana*) and adjacent Lasqueti Island (specimens in DAO). These islands lie in the Gulf of Georgia between Vancouver Island and the mainland of British Columbia. In addition Eastham (1947) recorded this species from Saanich Arm, Vancouver Island, on the basis of specimens in the British Columbia Provincial Museum. Taylor (1956) stated that this record may be in error because the plant has not been collected again in that area. A map of the British Columbia distribution is given in Plate 3.

The relationship of the Old World *W. radicans* L., to the eastern Asiatic *W. orientalis* Swartz and *W. unigemmata* Nakai, and to the American *W. fimbriata* J. E. Smith, *W. spinulosa* Martens & Galeotti and *W. martinezii* Maxon ex Weatherby would form the basis for a most interesting investigation.

In the course of the present study, specimens have been examined in the herbaria of the National Museum of Canada, Ottawa (CAN), the Department of Botany, University of Toronto (TRT), and Department of Botany, Queens University, Kingston (QUK), in addition to those preserved in the Department of Agriculture herbarium at Ottawa (DAO).

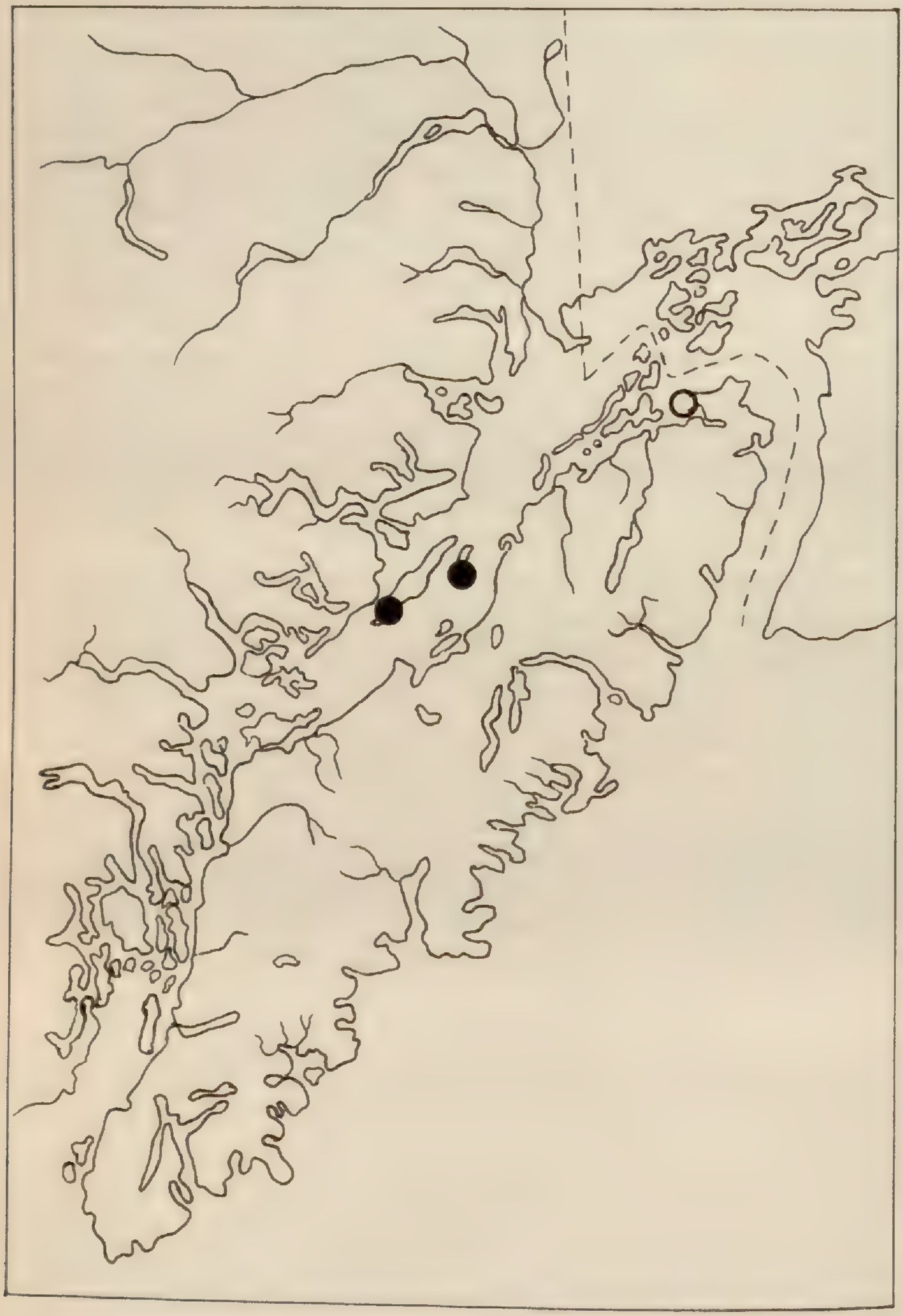
LITERATURE CITED

ABRAMS, L. R. 1923. Illustrated Flora of the Pacific States. Vol. I. Stanford University Press. Stanford, Calif., 557 pp. illus.

ALSTON, A. H. G. 1933. Certain Ferns in Sir James Smith's Herbarium. Philip. Jour. Sci. **50**: 181.

BRITTON, N. L. 1918. Flora of Bermuda. Charles Scribner's Sons, N.Y. 585 pp.

BRAYSHAW, T. C. 1959. Checklist of the Vascular Plants of Chalk River District [Ontario]. Can. Dept. N. Aff. & Nat. Res. Forest Res. Div. (Mimeographed) **59–9**: 22 pp.



Canadian Distribution of Woodwardia fimbriata
(Solid Circle, Specimens Seen; Open Circle, Literature Record)

BROUN, MAURICE. 1938. Index to North American Ferns. Orleans, Mass. 217 pp.

CODY, W. J. 1956. Ferns of the Ottawa District. Can. Dept. Agr. Pub. 974. 94 pp.

EASTHAM, J. W. 1947. Supplement to "Flora of Southern British Columbia." Brit. Col. Prov. Mus. Spec. Pub. No. 1. 119 pp.

ERSKINE, D. S. 1951. Species Newly or Rarely Reported from Nova Scotia and Cape Breton Island. Rhodora **53:** 265–271.

————. 1961. Plants of Prince Edward Island. Can. Dept. Agr. Pub. 1088. 270 pp.

FERNALD, M. L. 1921. The Gray Herbarium Expedition to Nova Scotia, 1920. Rhodora **23:** 153–171.

————. 1925. Persistence of Plants in Unglaciated Areas of Boreal America. Amer. Acad. Arts & Sci. Mem. 15. 241–342.

JACKSON, B. D. 1896. Bibliographical Notes, XII. The Dates of Rees's Cyclopaedia. Jour. Bot. London **34:** 307–311.

MACOUN, JOHN. 1890. Catalogue of Canadian Plants. Pt. 5. 428 pp.

MACOUN, JAMES M. 1899. Contributions to Canadian Botany, XIII. Ott. Nat. **13:** 158–169.

MARIE-VICTORIN, FRÈRE. 1935. Flore Laurentienne. Imprimerie de la Salle. Montréal. 917 pp. illus.

MAXON, W. R. 1919. Notes on American Ferns—XIV. Amer. Fern Jour. **9:** 67–73.

————. 1949. In Weatherby, C. A., Two Mexican Ferns. Amer. Fern Jour. **39:** 88–91.

ROLAND, A. E. 1941. Ferns of Nova Scotia. Proc. Nova Scotia Inst. Sci. **20:** 64–120.

————. 1947. Flora of Nova Scotia. op. cit. **21:** 95–642.

SCOGGAN, H. J. 1950. The Flora of Bic and the Gaspé Peninsula, Quebec. Nat. Mus. Can. Bull. 115. 399 pp.

TAYLOR, T. M. C. 1956. The Ferns and Fern-Allies of British Columbia. Brit. Col. Prov. Mus. Handbk. No. 12. 154 pp.

UNDERWOOD, L. M. 1907. Concerning Woodwardia paradoxa, a Supposedly New Fern from British Columbia. Torreya **7:** 73–76.

WHERRY, EDGAR T. 1921. The Soil Reactions of the Ferns of Woods and Swamps. Amer. Fern Jour. **11:** 5–16.

WIGGINS, IRA L. 1944. Collecting Ferns in Northwestern Mexico. Amer. Fern Jour. **34:** 37–49.

WRIGHT, C. H. 1907. New or Noteworthy Plants. Gard. Chron. III. **41:** 98.

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Ferns of Manitoulin Island, Ontario[1]

JAMES H. SOPER

Manitoulin Island is located in the northern part of Lake Huron (from 45°30′ to 46°00′ N. and 81°30′ to 83°15′ W.) and together with several neighboring islands and a small portion of the mainland to the northeast, constitutes the District of Manitoulin in the Province of Ontario, Canada. Geographically and geologically it is a link between the Bruce Peninsula to the southeast and Drummond Island and the northern peninsula of Michigan to the northwest. Manitoulin Island is roughly eighty miles long, thirty miles wide at the broadest portion, and has a land area of nearly 1100 square miles. About forty percent of the island is farm land. There are many inland lakes on the island, the three largest, Lakes Manitou, Mindemoya, and Kagawong, presenting a total water surface of over sixty-five square miles.

The island consists of southward-dipping rock plains of dolomite and limestone with series of perpendicular cliffs along the northern side. In the vicinity of West Bay, which is a deep bay on the northern shore of the island between Little Current and Gore Bay, one set of cliffs reaches a height of 1150 feet or about 570 feet above the level of Lake Huron. The most conspicuous promontory southeast of West Bay is called "High Hill" and this is believed to be the only part of the island which was not submerged by glacial Lake Algonquin. There is ample evidence of glaciation in the form of striae, erratic boulders and deposits of gravel, although the drift is a comparatively shallow covering on many parts of the island.

The flat rock plains and perpendicular cliffs of Manitoulin Island and the limestone pavements of La Cloche Peninsula, which connects Manitoulin to the mainland at the north, are in great contrast to the quartzite ridges and irregular granitic

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[1] A brief version of this paper was presented to the American Fern Society during the A.I.B.S. meetings at Purdue University, West Lafayette, Indiana, August 20, 1961.

knolls which occur on the mainland in the adjoining districts of Sudbury and Algoma. There are only a few small intrusions of Precambrian rock (mainly quartzites) in the vicinity of Sheguiandah, south of Little Current, near the northern edge of the island. A general account of the geography, settlement, and agriculture of the island has been given by Putnam (1947) and a soil survey has been presented by Hoffman et al. (1959).

BOTANICAL EXPLORATION

Until recently Manitoulin Island has received little attention from botanists. In 1866 Dr. John Bell made the first systematic collection of plants during a Canadian Geological Survey expedition to the islands of Lake Huron, but many of the localities cited in his published account (1870) are on St. Joseph Island (Algoma District) or on Drummond Island (Chippewa County, Michigan) west of Manitoulin. The only localities listed by Bell for "Grand Manitoulin" were Gore Bay, Cape Smyth [Smith], and Wequemakong [Wikwemikong] Bay. He also collected at several localities on Cockburn Island, which is between Manitoulin and Drummond Island. The collection made by John Bell has only recently come to light and has been deposited in the herbarium of Carleton University in Ottawa. I have examined all the pteridophytes and included citations for those for which specific locality data are available. Although Bell's list of plants includes thirty-nine pteridophytes, only seventeen of these are cited from localities in the Manitoulin District and two others are stated to be common in the region, making a total of nineteen species of pteridophytes reported from the district.

The only recent extensive collections prior to my own are those made by C. O. Grassl and W. Koelz in 1932. Their survey was made by boat from island to island and included many points and bays still inaccessible by automobile or on foot. I have seen all the pteridophyte material collected by Grassl and Koelz, the first set of which is deposited in the herbarium of the University of Michigan at Ann Arbor. Other collections examined included those by H. A. Senn, Senn & Lindsay, Jenkins & Dalton, W. G.

Dore, and W. J. Cody at the Plant Research Institute in Ottawa; and by several students from the University of Toronto and from the Ontario Agricultural College, Guelph, Ontario.

In 1932 N. C. Fassett visited Manitoulin and collected at High Hill, southwest of Little Current. He reported (1933, p. 389) that ". . . this escarpment appears like a promising territory for a botanist, but fires have been so devastating that most of the cliffs and talus slopes have become too dry to support much vegetation. A collector who could take the time to find moist sheltered places would probably discover much of interest." Two years later, M. L. Fernald stopped at La Cloche Peninsula en route to the Keweenaw Peninsula and made one brief stop on Manitoulin Island. According to his account (1935, p. 202) La Cloche Peninsula and Great Cloche Island were very interesting botanically, but his ". . . brief . . . invasion of much burned Manitoulin Island . . ." was rather unproductive. Most visiting botanists have merely penetrated the island for a short distance or passed through from Little Current to South Baymouth (or vice versa) while using the ferry service between the island and the Bruce Peninsula as a "short cut" to bypass Georgian Bay.

Fassett's prediction concerning the escarpment at High Hill as a promising territory for a botanist has proved to be correct, for the only Manitoulin records for *Asplenium viride*, *Camptosorus rhizophyllus*, and *Dryopteris filix-mas* are my collections from part of this escarpment. Such frequently rare and local species as *Pellaea atropurpurea* and *Asplenium ruta-muraria* var. *cryptolepis* are almost common on the talus slope along the east-facing part of High Hill. The effect of fires on the vegetation is still noticeable but they have by no means eliminated the interesting elements of the flora. *Pellaea atropurpurea* is common and abundant also on one obviously burned-over section of limestone pavement in the western part of the island.

My first visit to Manitoulin Island was in the late summer of 1949 when I attended the excursions of the American Bryological Society based on Birch Island, just north of Little Current. Only a few collections and some sight records for vascular plants

were made on that occasion. From 1952 to 1957, as part of my field work on the Flora of Ontario project, several visits were made to Manitoulin Island as well as to the Duck Islands, which lie south of the western half of Manitoulin. In 1959, with the able assistance of a student, Conrad Heidenreich, I made extensive collections on Great Duck Island, the western half of Manitoulin, and the area around South Baymouth. A short visit was also made in the same year to Cockburn Island west of Manitoulin. In September of 1961 and September of 1962 brief collecting trips were made in the eastern part of the island. The localities from which specimens and sight records have been obtained during the general floristic survey are shown in Plate 4.

In contrast to the rather discouraging judgment passed on Manitoulin Island by M. L. Fernald, I have found the flora extremely interesting. It contains some of the Great Lakes endemics and characteristic calciphiles, such as *Carex garberi*, *Tofieldia glutinosa*, *Zygadenus glaucus*, *Iris lacustris*, *Satureja arkansana*, and *Cirsium pitcheri*; some of the Bruce Peninsula "disjunct specialties" such as *Habenaria unalascensis*; northern species such as *Poa alpina*; and prairie species such as *Geum triflorum* and *Actinea acaulis*. An account of the seed plants is being prepared as a separate report, this paper dealing only with the pteridophytes.

THE FERN FLORA

For the fern specialists, the list of pteridophytes may not be as long as might be expected. This is due chiefly to the uniform nature of the underlying rocks, exposures and soils. The common oxylophiles of the Canadian Shield are almost entirely absent, for example *Woodsia ilvensis* is found only on the quartzite ridges near Sheguiandah. The scarcity of true sphagnum bogs on the island undoubtedly explains the rarity or absence of bog-loving species such as *Woodwardia virginica*. However, the abundance of rock exposures in the form of dolomitic cliffs and ledges and of limestone pavements with immumerable crevasses, results in local profusions of such calciphiles as *Asplenium tri-*

46°
Drummond
Island
83°
82°
46°
Cockburn Is.
G.B.
L.C.
L.K.
L. MIN.
L. MAN.
W. I.
M. I.
S. I.
Duck
Islands
P.B.
MANITOULIN ISLAND
S.B.M.
F.I.
45°30'
Middle
Duck
Great
Duck
Outer
Duck
1 Mile
LAKE HURON
8 4 0 8 16 24 32
Scale of Miles
Bruce
Peninsula
83°
82°
J.H.S.

chomanes, Cystopteris bulbifera, C. fragilis, Pellaea atropurpurea, and *Woodsia oregana* var. *cathcartiana.*

On the basis of my own field work and the limited amount of additional herbarium material which was available for study, it is possible to present the following preliminary classification of the pteridophytes with respect to abundance and distribution in the district.

GROUP I.—Common and abundant: *Botrychium virginianum, Dryopteris spinulosa* (sensu lato), *Polypodium vulgare* var. *virginianum, Pteridium aquilinum* var. *latiusculum.*

GROUP II.—Frequent and plentiful: *Asplenium trichomanes, Athyrium filix-femina* var. *michauxii, Cryptogramma stelleri, Cystopteris bulbifera, Cystopteris fragilis, Dryopteris marginalis, Equisetum arvense, Gymnocarpium dryopteris, Lycopodium annotinum, Matteuccia pensylvanica, Onoclea sensibilis, Woodsia oregana* var. *cathcartiana.*

GROUP III.—Occasional or locally abundant: *Equisetum fluviatile, Equisetum scirpoides, Lycopodium clavatum, Lycopodium lucidulum, Lycopodium obscurum* var. *dendroideum, Osmunda claytoniana, Osmunda regalis* var. *spectabilis, Selaginella apoda, Selaginella selaginoides, Thelypteris palustris* var. *pubescens, Thelypteris phegopteris.*

GROUP IV.—Rare and local: *Adiantum pedatum, Asplenium ruta-muraria* var. *cryptolepis, Dryopteris cristata, Equisetum hyemale, Equisetum pratense, Equisetum sylvaticum, Equisetum variegatum, Osmunda cinnamomea, Pellea atropurpurea, Pellaea glabella.*

GROUP V.—Very rare (known only from two or three stations): *Botrychium lunaria* var. *minganense, Botrychium matricariifolium, Equisetum laevigatum, Equisetum nelsonii, Equisetum palustre, Gymnocarpium robertianum, Lycopodium complanatum.*

GROUP VI.—Known from a single station or area: *Asplenium viride, Camptosorus rhizophyllus, Dryopteris filix-mas, Isoëtes muricata, Selaginella rupestris, Woodsia ilvensis.*

GROUP VII.—Reported but not confirmed (see discussion under Excluded Species): *Cryptogramma crispa* var. *acrostichoides, Thelypteris noveboracensis.*

PL. 4—REFERENCE MAP OF THE MANITOULIN ISLANDS SHOWING (BY DOTS) LOCATIONS WHERE PLANT COLLECTIONS AND SIGHT RECORDS HAVE BEEN TAKEN BY J. H. SOPER. INSET GIVES DETAILS FOR THREE OF THE DUCK ISLANDS. *Abbreviations*: F.I.—FITZWILLIAM IS.; G.B.—GORE BAY; I.—INNER DUCK IS.; L. C.—LITTLE CURRENT; L. K.—LAKE KAGAWONG; L. MAN.—LAKE MANITOU; L. MIN.—LAKE MINDEMOYA; P. B.—PROVIDENCE BAY; S. B. M.—SOUTH BAYMOUTH; W.—WESTERN DUCK IS.

GROUP VIII.—Not yet reported, but to be expected on the basis of the known range in Ontario and Michigan: *Phyllitis scolopendrium* var. *americana*, *Polystichum acrostichoides*, *Polystichum lonchitis*.

COLLECTION LOCALITIES

Many of the localities cited in this paper are not to be found on the commonly available small scale maps. Therefore the following list has been prepared from the National Topographic maps stating the latitude and longitude for geographical reference.

Baie Fine (N shore)	46°	02′ N.	81°	30′ W.
Barrie Island	45	56	82	37
Bass Lake	45	53	81	57
Battery Bluff	45	53	82	48
Big Bay	45	34	82	04
Big Lake	45	44	82	05
Birch Island	46	00	81	46
Bluejay Creek	45	36	82	05
Boom Point (Cockburn Is.)	45	51	83	21
Britainville	45	44	82	24
Campbell Bay	45	50	82	34
Cape Robert	45	59	82	48
Caves (L. Mindemoya)	45	45	82	15
Centre Island	45	56	81	39
Christina Bay	45	49	82	55
Cockburn Island (village)	45	57	83	19
Cook's Dock (in Cook's Bay)	45	53	82	48
Dawson Township	45	54	83	07
Dean Bay	45	41	82	19
Desert Point (Great Duck Is.)	45	41	82	56
East Bluff, Gore Bay	45	56	82	27
Evansville	45	49	82	37
Excelsior	45	49	82	09
Fall's Lake	45	54	83	06
Fitzwilliam Island	45	30	81	45
Fossil Hill	45	41	81	54
Frechette Bay	45	47	82	42
Frost Point	45	54	81	53
Froude's Harbour	45	36	82	00
Gore Bay	45	55	82	28
Gravel Harbour (Great Duck Is.)	45°	39′ N.	82°	56′ W.

Great Duck Island	45°	40′ N.	82°	57′ W.
Green Bay	45	51	82	01
Grondine Point (N shore)	45	55	81	08
Helen Bay	45	50	82	38
Heywood Island	45	56	81	46
High Falls	45	48	81	51
High Hill	45	51	82	06
Honora	45	53	82	06
Horseshoe Bay (Great Duck Is.)	45	40	82	58
Ice Lake	45	53	82	23
Indian village (South Bay)	45	38	81	48
Inner Duck Island	45	46	82	55
James Bay	45	42	81	40
Jocko Bay (Roberts Bay)	45	35	81	54
Kaboni	45	44	81	43
Kagawong	45	54	82	16
Killarney (N shore)	45	58	81	30
La Cloche Peninsula	46	02	81	46
Leask Bay	45	40	81	50
Leask Point	45	40	81	51
Lily Lake	45	53	83	05
Little Current	45	59	81	56
McKim's Beach	45	35	82	01
McLeod Harbour (Cockburn Is.)	45	53	83	18
Manitou Lake	45	43	81	57
Manitou River (mouth)	45	36	82	06
Manitowaning	45	45	81	49
Marsh Lake	45	44	82	27
Meldrum Point	45	57	83	09
Michael Bay	45	36	82	06
Middle Duck Island	45	42	82	55
Mindemoya	45	44	82	10
Mississagi Strait	45	54	83	14
Mud Lake (S of Sandfield)	45	39	81	55
Murphy Point	45	47	82	41
Narrow Bay (N shore)	46	02	81	34
Outer Duck Island	45	39	82	55
Owl Lake	45	34	82	04
Perch Lake	45	54	82	01
Poole Lake	45	35	82	03
Portage Bay	45	45	82	32
Providence Bay	45	40	82	16
Queen Point	45	47	82	53

Rattlesnake Harbour (Fitzwilliam Is.)	45°	31′ N.	81°	43′ W.
Rickett Harbour (Cockburn Is.)	45	53	83	18
Roberts Bay	45	35	81	54
Sandfield	45	42	82	00
Sheguiandah	45	54	81	56
Silver Lake	45	52	82	54
Silverwater	45	52	82	51
Sounding Cove	45	54	82	07
South Bay	45	39	81	50
South Baymouth	45	34	81	01
Strawberry Island	45	56	81	52
Tamarack Point (opp. Fitzwilliam Is.)	45	37	81	43
Tamarack Point (West Bay)	45	55	82	07
Tehkummah	45	39	82	01
Tehkummah Township	45	37	82	03
Ten-mile Point	45	53	81	50
Thomas Bay	45	34	81	56
Thompson Point (opp. Strawberry Is.)	45	57	81	53
Thompson Point (Cockburn Is.)	45	59	83	21
Tolsma Bay (Cockburn Is.)	45	57	83	19
Treasure Island (L. Mindemoya)	45	46	82	11
Wekwemikongsing	45	43	81	41
West Bay	45	52	82	09
Western Duck Island	45	45	83	00
Whiskey Island (William Is.)	45	51	81	38
Whitefish Falls (N shore)	46	07	81	44
Whitefish River Indian Reserve	46	04	81	43
Wikwemikong	45	49	81	43
William Island	45	51	81	38
Windfall Lake	45	42	82	04

SYMBOLS AND ABBREVIATIONS

Four types of symbols have been used to distinguish the different kinds of distribution records on the maps. The locations of collections of specimens made by the author (or by others as examined in various herbaria) are shown as solid round dots; those for plants examined by the author in the field or in the herbarium, but not preserved—as open circles; published reports considered authentic—as solid triangles; and other records, such as personal communications, both oral and written, from other collectors, when the information seemed credible on

the basis of the known distribution—as open triangles. All these records are on file in the Catalogue of Vascular Plants which is the result of personal research by the author and is housed in the Department of Botany at the University of Toronto.

The abbreviations for herbaria from which material is cited are those given by Lanjouw & Stafleu (1959). My own collections are cited by number preceded by the initial letter "S" or by a combination of letters to include the name of the field assistant or companion. The initial letters used and the names they represent are as follows: C—J. Clayson; Co—F. S. Cook; D—H. M. Dale; F—G. Fleischmann; G—J. G. Grevatt; H—C. E. Heidenreich; K—J. Kennedy; M—P. F. Maycock; S—J. H. Soper.

ANNOTATED LIST OF SPECIES

For each taxon in the following list I have cited my own collections first, giving habitat data, locality, date and number. These specimens are deposited in the herbarium of the Department of Botany at the University of Toronto (TRT). Then follows a list of sight records compiled from "sight cards" which were filled out in the field for each locality visited and later filed as a source of additional data on distribution. These are field observations for which no voucher specimens were taken but their usefulness in filling in distribution patterns is easily appreciated by examining the records plotted on the map of a common species such as *Botrychium virginianum* (see Fig. 1). The geographical order of citation of localities is Manitoulin Island, Cockburn Island, Duck Island, La Cloche Island and Peninsula, and finally the mainland portion of the District of Manitoulin. A general statement of the abundance and local distribution is also given, together with a condensed list of other collections examined and references to published reports when they furnish additional localities.

OPHIOGLOSSACEAE

1. BOTRYCHIUM LUNARIA (L.) Sw. var. MINGANENSE (Vict.) Dole—In depression of open wooded sand dunes, Providence Bay, 25 June 1961. *S & M*

9234. Great Duck Is.: in open grassy clearing near shore, Gravel Harbour, 23 June 1959, *S & H 8593*; loc. cit., 25 June 1959, *S & H 8619*.

The Moonwort is represented only by the variety *minganense* and is rare in the district. No other collections have been found.

2. BOTRYCHIUM MATRICARIIFOLIUM A. Br. ex Koch—In low damp woods near small lake N of Silverwater, 29 July 1959, *S & H 9035*. Great Duck Is.: dense woods around edge of swamp lake near S end of island, 26 June 1959, *S & H 8651*. I have not seen any other records for this species.

3. BOTRYCHIUM VIRGINIANUM (L.) Sw.—In damp woods on limestone flats, Providence Bay, 27 July 1952, *S & C 5687*; damp thicket at base of rocky ridge, Mud Lake, 5 July 1957, *S & G 7170*; dense maple woods along trail near Manitou Lake, 5 miles W of Manitowaning, 18 June 1959, *S & H 8521*; cedar woods near lake shore, Christina Bay, 19 July 1959, *S & H 8828*.

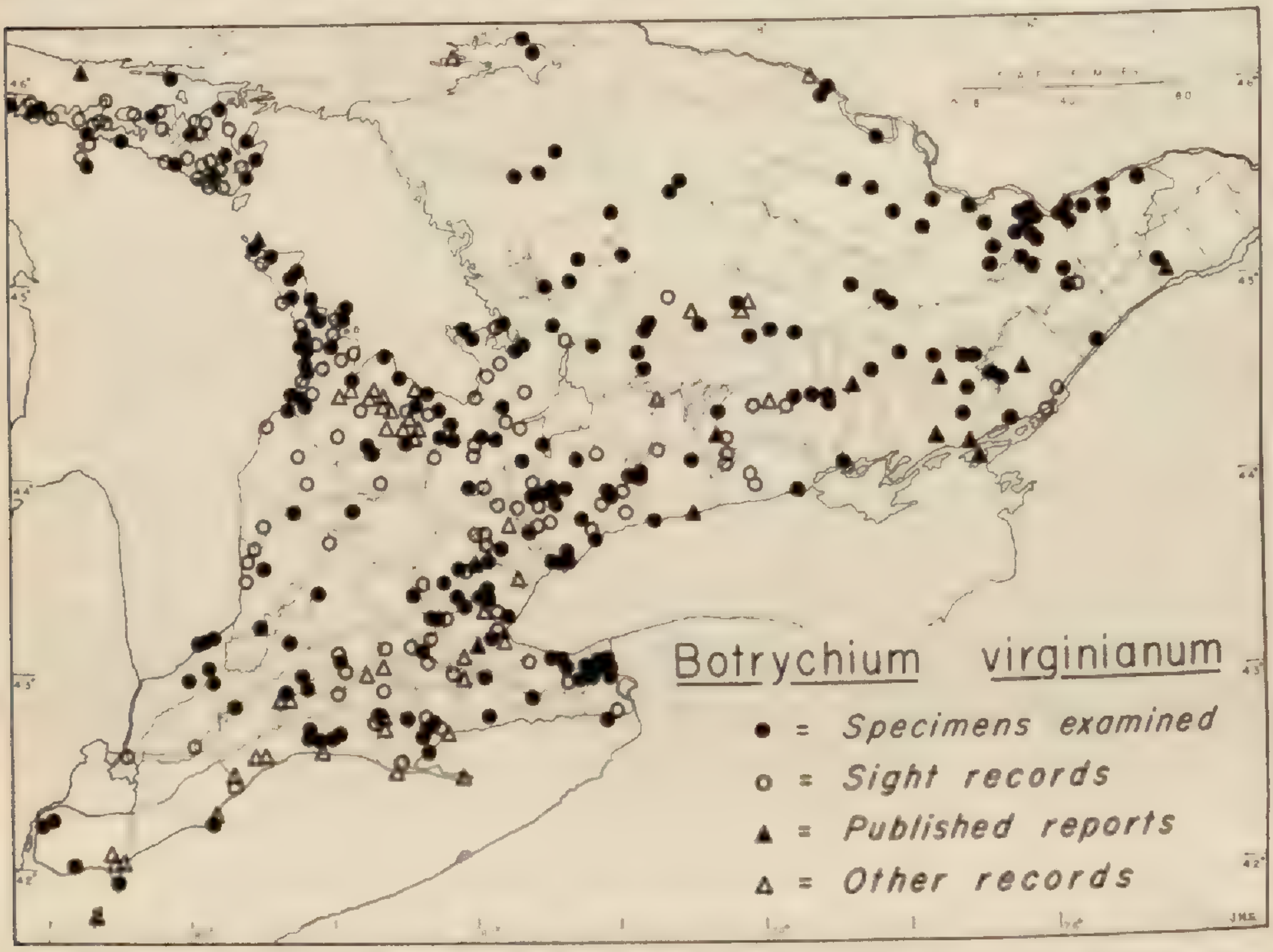


FIG. 1—DISTRIBUTION OF *Botrychium virginianum* IN SOUTHERN ONTARIO.

Sight records: Barrie Is., Bluejay Creek, Cape Robert, Cook's Dock, Dean Bay, Frechette Bay, Green Bay, Ice Lake, Kaboni, Michael Bay, Mindemoya, Perch Lake, Poole Lake, Roberts Bay to Thomas Bay, Silver Lake, Silverwater, South Baymouth, Sounding Cove, Tehkummah, Ten-mile Point; Cockburn Is.; Inner and Outer Duck Islands.

The Rattlesnake Fern is common on Manitoulin Island as elsewhere in the southern part of Ontario (see Fig. 1). It also occurs in northern On-

tario but records are scarce beyond 53° N. latitude. Other collections examined: Wekwemikongsing, Tamarack Point and Little Current, *C. O. Grassl 1446, 1447, & 5836* (MICH); Gore Bay, *M.C.T.* [*Thomson?*] (TRT #23053); 14 miles SW of Manitowaning, *Senn & Lindsay 5494* (DAO); Murphy Point, *H. A. Senn 6027* (DAO); West Bay, *H. H. Brown 5543* (TRT); Wikwemikong, *E. C. & E. B. Ogden 2398* (DAO, GH, NYS).

OSMUNDACEAE

4. OSMUNDA CINNAMOMEA L.—The Cinnamon Fern is rare and local on Manitoulin Island. It has been seen only in four localities: north shore of Marsh Lake; Cockburn Is.; south shore of Great Duck Island; N of the E-W trail across Great Duck Is.

Collections examined: 4 miles NE of West Bay, *H. H. Brown 5571* (TRT); Great Duck Is., *C. O. Grassl 5864* (MICH).

5. OSMUNDA CLAYTONIANA L.—At edge of cedar woods 3 miles NW of South Baymouth, 30 June 1959, *S & H 8719;* on damp hillside along intermittent stream in gorge, 4 miles NE of Gore Bay, 28 July 1959, *S & H 9018;* along wooded bank of Manitou River 1 mile N of Michael Bay, 14 Sept. 1961, *S & Co 9325.* Cockburn Is.: along edge of wet woods 3 miles SW of Tolsma Bay, 10 June 1959, *S & H 8505.* Great Duck Is.: on E-W transect from Gravel Harbour to Horseshoe Bay, 23 June 1959, *S & H s.n.* (TRT # 124676).

The Interrupted Fern is only an occasional species in the area. Other collections: McKim's Beach, *K. K. Irizawa 100* (TRT); Cockburn Is., *W. Koelz 4417 & 4474* (MICH).

6. OSMUNDA REGALIS L. var. SPECTABILIS (Willd.) Gray—In hummocks in marshy ground, Mud Lake, 5 July 1957, *S & G 7174;* at edge of quaking mat around bog lake NW of Silver Lake, 20 July 1959, *S & H 8898;* damp woods along bank of Manitou River near its mouth, 14 Sept. 1961, *S & Co 9315.* Great Duck Is.: at edge of marsh near S end of island, 10 July 1953, *S & K 5895;* loc. cit., 26 June 1959, *S & H 8646.* Sight record: lot 21, concession X, Cockburn Island.

The Royal Fern is occasional and local in wet habitats. Other collections: Leask Bay, *W. Koelz 4179* (MICH); Sheshigwaning, *M. Wilton* (OAC # 29258); Queen Point, *P. Dean* (OAC #31663). Reported from Gore Bay and from Thompson Point and McLeod Harbour on Cockburn Island by Bell (1870).

LITERATURE CITED

BELL, JOHN. 1870. On the Plants of the Manitoulin Islands. Appendix to Report of Progress from 1866-1869, Geol. Surv. Can., pp. 449-469.

FASSETT, N. C. 1933. Notes from the Herbarium of the University of Wisconsin—X. Rhodora **35:** 387-391.

FERNALD, M. L. 1935. Critical Plants of the Upper Great Lakes Region of Ontario and Michigan. Rhodora **37:** 197-222; 238-262; 272-301; 324-341.
HOFFMAN, D. W., WICKLUND, R. E., & N. R. RICHARDS. 1959. Soil Survey of Manitoulin Island, Ontario. Report No. 26, Ont. Soil Surv., Ont. Agric. Coll., Guelph. 85 pp.
LANJOUW, J., & F. A. STAFLEU. 1959. Index Herbariorum. Ed. 4. Utrecht.
PUTNAM, D. F. 1947. Manitoulin Island. Geogr. Rev. **37:** 649-662.

(To be continued)

DEPARTMENT OF BOTANY, UNIVERSITY OF TORONTO, TORONTO, CANADA.

Cytology of Some Genera of Polypodiaceae in Eastern India. II

S. N. PATNAIK AND G. PANIGRAHI

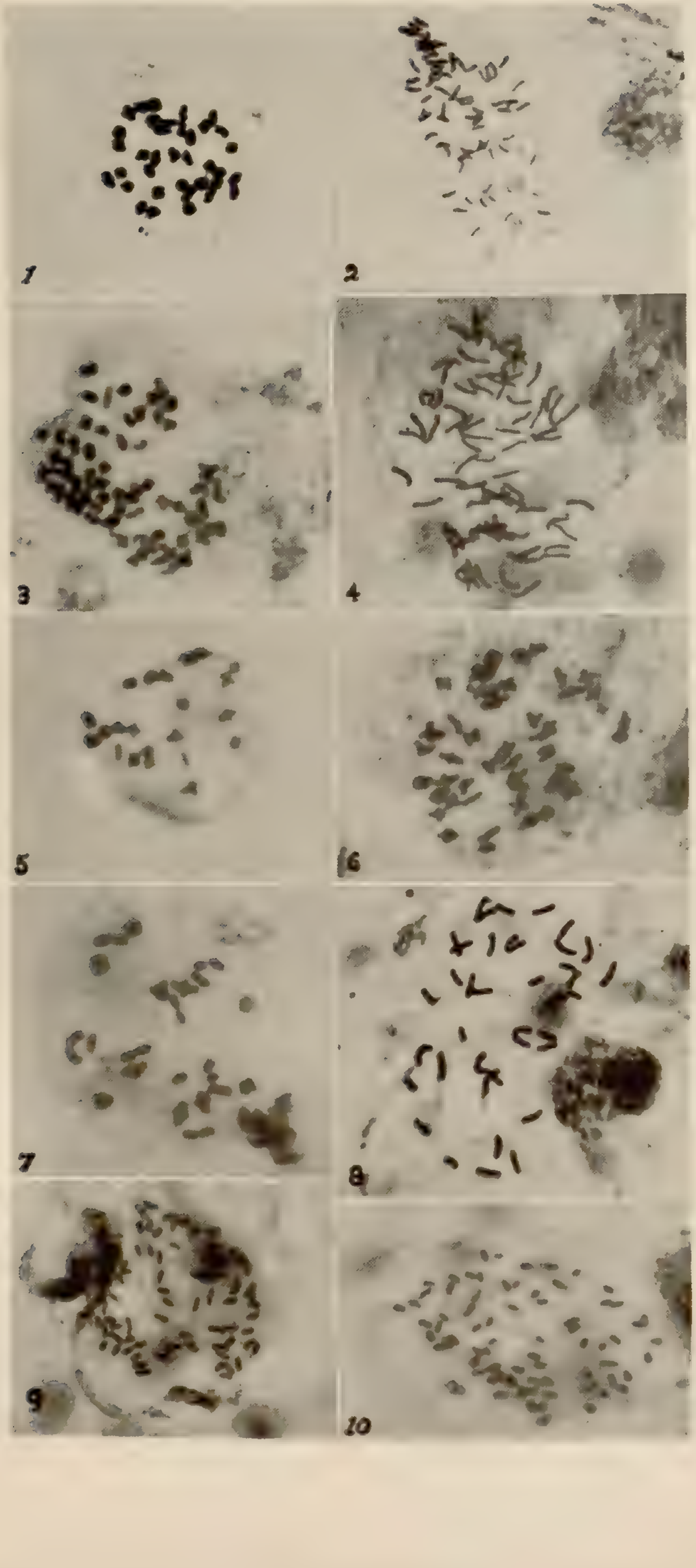
The Polypodiaceae (*sensu* Copeland, 1947) represented by 27 genera and 106 species in India, occurs generally in the tropical and subtropical evergreen forests of Eastern India and comprises predominantly epiphytic members growing on tree trunks or humus-covered boulders, although a few terrestrial species (viz. *Dipteris wallichii*) creep on the surface of sandy soil over rocky substrata. Although Manton (1954) and Manton and Sledge (1954) studied the cytology of nearly 40 species of Polypodiaceae, mostly from Ceylon and Malaya, very few Indian species were investigated cytologically until recently when Malhotra (see Mehra, 1961), Pal (1961), Panigrahi and Patnaik (1961), reported the chromosome numbers of various Indian species. This paper records the chromosome numbers of 19 other East Indian species and one variety of the family (Table 1), mostly from the Khasi and Jaintia Hills of Assam, and may be treated as a continuation of our earlier publication (1961), recording chromosome numbers of 18 species from Eastern India.

Manton (1950) studied the cytology of the *Polypodium vulgare* complex in Europe and established the basic chromosome number of $x=37$ for the genus *Polypodium*. Recently Mehra (1961), quoting Malhotra's work reported the haploid number as $n=37$ in 5 Indian species of the genus from Darjeeling and

TABLE I

Name of fern	Locality of collection	Chromosome number	Degree of Ploidy
1. *Dipteris wallichii* (R.Br.) Moore	Umsaw	$n=66$	Tetraploid
2. *Drynaria propinqua* (Wall.) J. Sm.	Shillong	$n=36$	Diploid
		$2n=72$	Diploid
3. *Drynaria quercifolia* (L.) J. Sm.	Garo Hills	$n=37$	Diploid
4. *Goniophlebium argutum* (Wall.) J. Sm.	Shillong	$n=36$	Diploid
5. *Lemmaphyllum subrostratum* (C. Chr.) Ching	Shillong	$2n=72$	Diploid
6. *Lepisorus contortus* (Chr.) Ching	Shillong	$n=23$	Diploid
		$2n=46$	Diploid
7. *Lepisorus subconfluens* Ching	Shillong	$n=47$	?
		$2n=94$	?
8. *Lepisorus macrosphaerus* (Bak.) Ching	Shillong	$n=35$	Diploid
9. *L. macrosphaerus* var. *asterolepis* (Bak.) Ching	Shillong	$n=35$	Diploid
10. *Microsorium lucidum* (Roxb.) Copel.	Garo Hills	$n=36$	Diploid
11. *Microsorium zippelii* (Bl.) Ching	Upper Dihing R. F.	$n=36$	Diploid
12. *Neocheiropteris phyllomanes* (Christ) Ching	Shillong	$n=36$	Diploid
		$2n=72$	Diploid
13. *Polypodium amoenum* Wall.	Shillong	$n=36$	Diploid
		$2n=72$	Diploid
14. *Polypodium lachnopus* Wall.	Shillong	$n=36$	Diploid
15. *Polypodium microrhizoma* Clarke	Shillong	$n=36$	Diploid
16. *Pyrrosia beddomeana* (Gies.) Ching	Tirap F. D.	$2n=74$	Diploid
17. *Pyrrosia mollis* (Kze.) Ching	Shillong	$n=74$	Tetraploid
18. *Pyrrosia nummulariifolia* (Sw.) Ching	Umsaw	$n=37$	Diploid
		$2n=74$	Diploid
19. *Pyrrosia nuda* (Gies.) Ching	Umsaw	$2n=$ca.144	Tetraploid
20. *Belvisia callifolia* (Christ) Copel.	Cherrapunji	$n=35$	Diploid

Manton (1954) reported $n=$ca. 37 in 3 species of *Polypodium* from Malaya. But astonishingly the Shillong biotypes of 3 species of *Polypodium* and one species of *Goniophlebium* show un-


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mistakably $n=36$ in each case (Fig. 1), which is also confirmed by the roottip count of $2n=72$ in *P. amoenum* Wall. (Fig. 2).

The cytology of *Dipteris conjugata* Reinw. was studied by Manton (1954) (using Malayan material), and she obtained an approximate count of $n=$ca.33 at meiosis. But *Dipteris wallichii* (R. Br.) Moore from Assam shows 66 clear bivalents at diakinesis (Fig. 3) which, therefore, confirms the basic chromosome number $x=33$ for the genus and establishes *D. wallichii* (R. Br.) Moore as a tetraploid species.

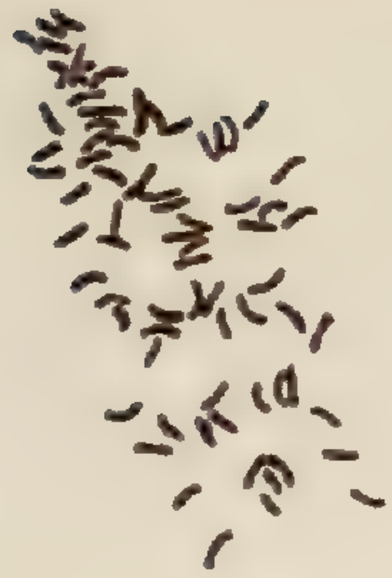
Both Bower (1928) and Holttum (1954) treated *Neocheiropteris* as a connecting link between *Dipteris* and *Pleopeltis*. While Copeland (1947) recognized *Neocheiropteris* as evidently related to *Pleopeltis*, he considered the former genus as too recent in origin as to be treated as a connecting link either between *Pleopeltis* (=*Lepisorus*) and *Microsorium* or between *Dipteris* and *Pleopeltis* (=*Lepisorus*). The discovery of $x=36$ (viz. $2n=72$) both in *Neocheiropteris* (Fig. 4) and *Lepisorus longifolius* (Bl.) Holtt. (cf. Manton, 1954) and advanced morphological and anatomical features in *Neocheiropteris* in contrast to the discovery of $x=33$ in *Dipteris*, which is characterized by the most primitive characters of gross morphology, may support Copeland's contention that *Neocheiropteris* has been derived from *Lepisorus*-like ancestors.

The discovery of $n=36$ in *Drynaria propinqua* (Wall.) J. Sm. from Shillong (cf. fig. 9) in contrast to $n=37$ in *D. quercifolia* (L.) J. Sm. from the Garo Hills and the nature of pairing at meiosis in the latter species (Table 2) may be cited here as of cytological and evolutionary interest.

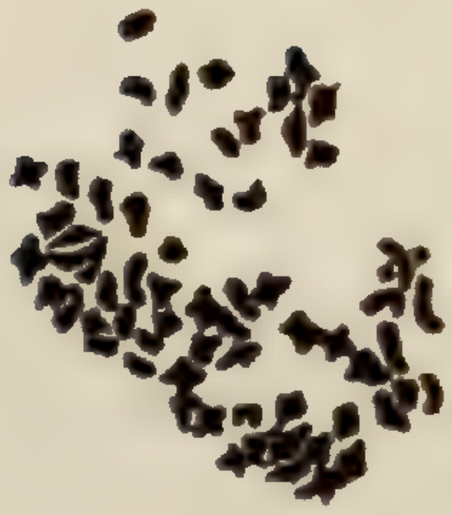
FIG. 1. POLYPODIUM LACHNOPUS, $n=36$. FIG. 2. POLYPODIUM AMOENUM, $2n=72$. FIG. 3. DIPTERIS WALLICHII, $n=66$. FIG. 4. NEOCHEIROPTERIS PHYLOMANES, $2n=72$. FIG. 5. LEPISORUS SP., $n=22$. FIG. 6. LEPISORUS SUBCONFLUENS, $n=47$. FIG. 7. LEPISORUS PSEUDONUDUS, $n=17^{II}+5^{I}$. FIG. 8. LEPISORUS PSEUDONUDUS, $2n=39$. FIG. 9. DRYNARIA PROPINQUA, $2n=72$. FIG. 10. LEMMAPHYLLUM SUBROSTRATUM, $2n=72$. FIG. 3, REPRODUCED AT MAGNIFICATION OF × 1450. ALL OTHERS × 465. EXPLANATIONS APPLY TO BOTH PLATES 5 AND 6.



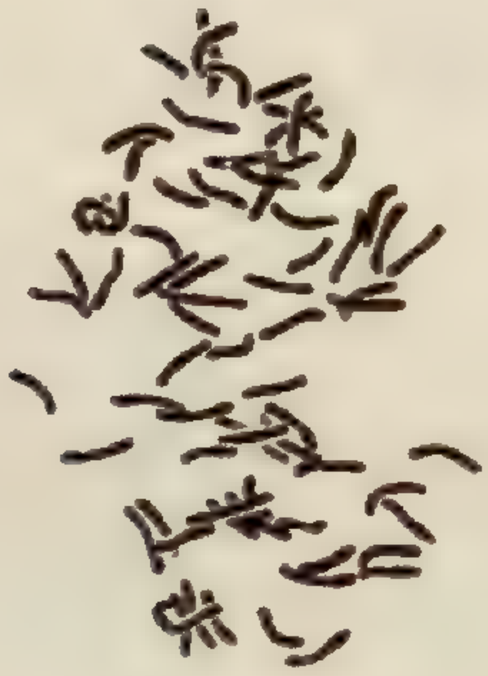
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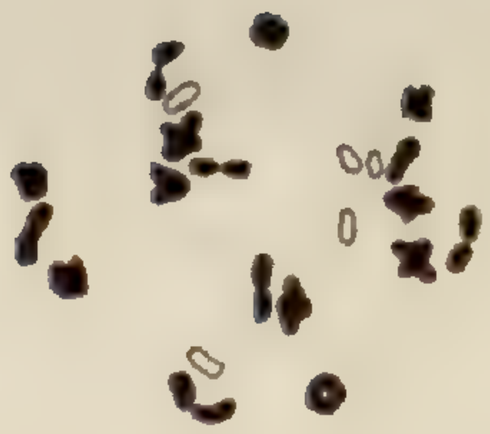
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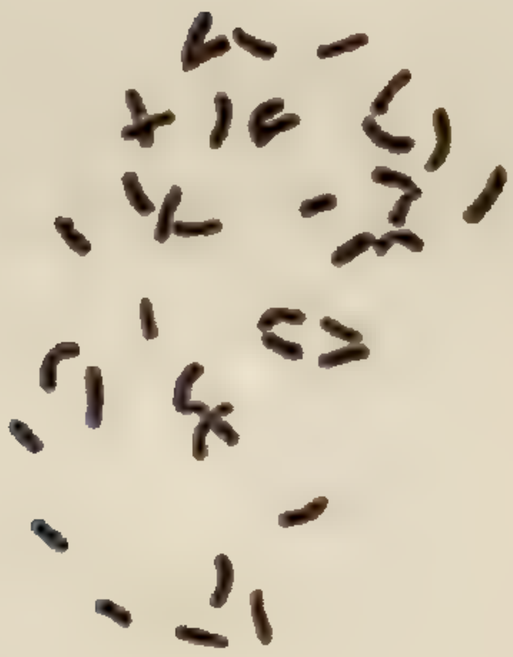
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TABLE II

Meiotic analysis in *Drynaria quercifolia* (L.) J. Sm. from Garo Hills of Assam

Total No. of spore mother cells studied	No. of cells showing: 37^{II}	No. of cells showing: $35^{II}+1^{IV}$	No. of cells showing: $36^{II}+2^{I}$	No. of cells showing: $35^{II}+4^{I}$
56	20	5	22	9

The variation in pairing as observed above and the formation of one tetravalent or 4 univalents in 14 of the 56 cells analyzed may suggest the duplication of one pair of chromosomes in the haploid complement of $n=36$ in *D. propinqua* (Wall.) J. Sm., the duplicated set showing, however, either incomplete homology or structural translocations in varying degrees in different cells.

The cytological behavior of *D. propinqua* and *D. quercifolia* may, therefore, provide an answer for the origin of different aneuploid base numbers as found in the genera *Pyrrosia, Polypodium, Crypsinus* and *Lepisorus* etc., which show certain amounts of "wobbling" around the common base numbers.

Lastly, *Lepisorus*, which appears to be in a very fluid state of evolution, shows an astonishing array of haploid chromosome numbers, viz. $n=22$ (Fig. 5), 23, 26, 35, 36, 47 (Fig. 6), 74 and $2n=39$ (Fig. 8), a most unusual cytological feature within the family Polypodiaceae. The close resemblance in morphological features between these cytological types in *Lepisorus* (*Pleopeltis linearis* complex *sensu* Beddome) and occurrence of the same base number, viz. $x=36$ in *Microsorium, Phymatodes, Colysis, Leptochilus, Aglaomorpha* and *Photinopteris* (all included within the group Microsorieae) and *Lemmaphyllum* and *Neocheiropteris* (Fig. 4) (included in Pleopeltideae of Copeland, 1947), considered together with the evidence of comparative morphology (Panigrahi and Patnaik, 1962), undoubtedly establish *Lepisorus* as an evolutionary plexus holding the key to the evolution at generic and family levels within the order Polypodiales (*sensu* Pichi-Sermolli, 1959).

Grateful thanks are due to Father H. Santapau, S. J., Chief

Botanist, Botanical Survey of India, Calcutta, for encouragement, and to the authorities of the Council of Scientific and Industrial Research, New Delhi, for financial assistance, including award of a Junior Research Fellowship to the senior author.

LITERATURE CITED

BOWER, F. O. 1928. The Ferns, Vol. III. Cambridge University Press.

COPELAND, E. B. 1947. Genera Filicum. Waltham, Massachusetts.

HOLTTUM, R. E. 1954. Flora of Malaya, Vol. 2. The Ferns. Singapore.

MANTON, I. 1950. Problems of Cytology and Evolution in the Pteridophyta. Cambridge University Press.

———. 1954. Cytology of One Hundred Ferns. Appendix, R. E. Holttum. Flora of Malaya, Vol. 2. The Ferns. Singapore.

MANTON, I., and W. A. SLEDGE. 1954. Observations on the Cytology and Taxonomy of the Pteridophyte Flora of Ceylon. Phil. Trans. Roy. Soc. **238:** 127-185.

MEHRA, P. N. 1961. Chromosome Numbers in Himalayan Ferns. Research Bull. (N. S.) Punjab Univ. **12:** 139-164.

PAL, S. 1961. Chromosome Numbers in Some Genera of Polypodiaceae. Sci. & Cult. **27:** 499-501.

PANIGRAHI, G., and S. N. PATNAIK. 1961. Cytology of Some Genera of Polypodiaceae in Eastern India. Nature (London) **191:** 1207-1208.

———. 1962. Phylogenetic Studies in Polypodiaceae. Mem. No. 4, Jour. Indian Bot. Soc. (In press).

PICHI-SERMOLLI, R. E. G. 1959. Pteridophyta. Vistas in Botany. London.

BOTANICAL SURVEY OF INDIA, EASTERN CIRCLE, SHILLONG, INDIA

American Fern Society

ANNUAL MEETING:—The 1963 annual meeting of the American Fern Society will be held in conjunction with the meetings of the AIBS at the University of Massachusetts, in Amherst, August 26-31. The Fern Society's program will include at least one session—two if necessary—for presentation of papers and the annual luncheon during one day, probably Tuesday, August 27th. A foray is planned for the week end of August 24-25.

It is hoped that a number of members will avail themselves of the opportunity to attend these meetings and to present papers describing their investigations of ferns. Each one wishing to

present a paper should send the following information to Mrs. Lenette Atkinson, 415 South Pleasant Street, Amherst, Massachusetts, by May 15th: title of paper, time required for its presentation (10 to 20 minutes), size and kind of projection equipment needed, if any. Please send in your title promptly, because late requests for a place on the program may have to be denied. Let Mrs. Atkinson have your response soon—as far ahead of the deadline as possible

Report of the President for 1962

This past year has been different from the standpoint of shifts among the officers of the Society. The newly elected President, Professor H. L. Blomquist, was stricken with illness soon after his election. On February 21st he notified the Council, through the Secretary, that he wished the Vice-President to serve in his place during the remainder of the year, and his request was granted. Dr. Donovan S. Correll was selected to fill the Vice-President's office during the rest of the year. On March 26th, Dr. Tom S. Cooperrider asked that he be relieved of his task as custodian of back numbers of the Journal not later than December 31st. Conrad V. Morton secured the services of David L. Emory and the shipment of back numbers of the Fern Journal was made in August. On June 5th word was received from Mr. Morton that Mrs. Kathryn R. Boydston desired to be relieved of responsibility for the Spore Exchange, which was started under her supervision several years ago. Conrad also found that Mr. Neill D. Hall was willing to carry on as custodian, and early in August the spore exchange material was shipped to him in Seattle. Since it had been more than a year after Dr. A. C. Smith had requested that a new American Fern Society representative to the American Association for the Advancement of Science be appointed, in September Dr. Walter H. Hodge was named to an indefinite term in that capacity.

The annual meeting in 1962 was with the American Institute of Biological Sciences summer meetings in Corvallis, Oregon. Miss La Rea J. Dennis acted very efficiently as our local repre-

sentative. Our meeting room was adequate and the luncheon well organized. Thanks are due her for successfully arranging for our activities.

The American Fern Society joined with other societies in a joint pre-meeting foray to the Oregon coast. Dr. Kenton L. Chambers and Miss Dennis were in charge of this foray and we are grateful to them for a good field trip. A special post-meeting Fern Society Foray was led by Professor William H. Baker, who showed us the ferns of Fairview Mountain and of the Crater Lake area. We are indebted to Professor Baker for carrying through this memorable three-day foray.

Our thanks are extended also to Dr. T. Delevoryas for organizing the symposium on "The Origin and Evolution of Ferns," given on Tuesday, as part of the AIBS program, and which credited the American Fern Society as a co-sponsor. Several of our members participated and presented excellent papers.

The work of the Society was guided by our capable Secretary, Dr. Donald G. Huttleston, in his fourth year of service in this capacity. The finances of the Society were in the very efficient hands of Dr. Richard L. Hauke, who had an extra burden in his first year in office while operating with a budget unconfirmed for a time owing to the changes among the officers. The Editor-in-Chief continued his efforts to keep Journal expenses down and to secure funds with which to reprint back numbers out of print or at a low level of reserves. Those who missed the contributions of Dr. Donovan S. Correll, our Vice-President, at the AIBS meetings, or have not read his literary accomplishments published by the Texas Research Foundation, have missed treats.

As a result of the recent election the Council for 1963 has only one new member. Mrs. Lenette Atkinson has been elected Secretary for a two-year term. It will make her work much easier if those who will be attending the annual meetings in Amherst in August will prepare papers on their fern investigations for presentation during our formal program. The programs of affiliated societies planned for the August meetings of the AIBS usually are required from each society Secretary by May 15. So

please send your titles and other requests for facilities for giving your papers to Mrs. Atkinson by May 15th in order that she may have time to arrange our program. Let's have a full day's session for contributed papers this year instead of a half day program!

Respectfully submitted, ROBERT C. LOMMASSON, *President*

Report of the Secretary for 1962

An increase in membership of 41 has been attained since last December, bringing the total to the all-time high of 896. Of this total, 79 members are outside continental United States and represent 28 countries. Forty-six of the 50 states are represented with Hawaii, Nevada, New Mexico and North Dakota having no members. (Certainly there must be fern enthusiasts in these states, particularly in Hawaii.) The three states with the largest memberships are California — 129, New York — 96, and Florida — 56.

With great regret I report the death of seven long-time members, including two life members: Mrs. Anson S. Blake (1945) (see Vol. 52, p. 134), Mr. Albert Chandler (1941), Life Member Mrs. W. D. Diddell (1935), Life Member John E. Marble (1928). Ernest J. Palmer (1909), and Miss Mary F. Wright (1925).

Three field trips were sponsored or co-sponsored by the American Fern Society this year, two in Oregon in connection with the annual meeting of the American Institute of Biological Sciences, and the third by the Fern Society only, in New England in July. All three were reported in Vol. 52, pp. 164-167, of the Fern Journal.

The annual meeting of the Society was held in connection with the A. I. B. S. on the campus of the Oregon State University, Corvallis, on August 8. Nearly forty persons attended. A list of the papers presented is as follows: "The Genus *Lycopodium* in Idaho," by William H. Baker; "Chromosome Counts of Some British Columbia Ferns," by T. M. C. Taylor (read by Frank A. Lang); "Studies on Gametophytes of *Pellaea*," by Thomas R. Pray (by title only); "Ferns and Fern Allies of Chihuahua," by

Donovan S. Correll; "The *Polypodium vulgare* Complex in the Pacific Northwest," by Frank A. Lang; "The Evidence for the Hybrid Origins of the Florida Spleenworts, *Asplenium biscayneanum, A. curtissii* and *A. plenum*," by Warren H. Wagner, Jr.; "The Microclimate of the Hart's-tongue," by Merle Gates and Jay Rigby (read by Mildred Faust); "The Gametophyte of *Anemia*," by Lenette R. Atkinson; "Ferns of the Morro Bay Area," by Robert J. Rodin; "A Facultative Geophytic Fern from Nigeria," by F. R. Fosberg; "Problems in Identifying Cultivated Ferns," by Barbara Joe Hoshizaki; "*Notholaena californica* and *Cheilanthes brandegei* in Baja California," by Ira L. Wiggins; "A Revision of Hawaiian Species of *Cibotium*," by V. J. Krajina.

The President of the American Fern Society, Dr. Robert C. Lommasson, presided over both the session for contributed papers and at the luncheon which followed the formal program. Thirty-four members attended the annual luncheon.

On August 28 the American Fern Society, together with the Paleobotanical, Systematic and General Sections of the Botanical Society of America, the American Society of Plant Taxonomists, and the Society for the Study of Evolution, co-sponsored a day-long symposium on the Origin and Evolution of Ferns. This was presided over by Dr. Arthur Cronquist and attracted a great deal of interest. During the morning, fossil ferns and fern allies were discussed by Francis M. Huebner, Harlan P. Banks, Charles B. Beck, Donald A. Eggert, and Chester A. Arnold. During the afternoon, living ferns and fern allies were discussed by David W. Bierhorst, Richard A. White, Rolla Tryon, and Warren H. Wagner, Jr. Although no profound conclusions were reached, many interesting points and much speculation was brought out.

It is with mixed feelings that I reach the end of my Secretaryship. Although I have enjoyed greatly the associations and the work has not been arduous, relief from the responsibility will be welcome, and I feel that four years is long enough for one person to hold the office. I am sure that Mrs. Atkinson will "carry the banner" most ably.

Respectfully submitted, D. G. HUTTLESTON, *Secretary*

Report of Treasurer for 1962

At the end of my first year as Treasurer of the American Fern Society, I am pleased to report that the Society's reserves have reversed the trend my predecessor noted in his last report. Despite increased expenditures for publishing the Journal, we were able to finish the year with over $1000 cash on hand, more than enough to cover outstanding bills. Several factors contributed to this improvement in our financial position. An increase to $3 for annual subscriptions to the American Fern Journal has increased receipts from subscribers. We have received more from gifts this year than last, thanks mostly to the brisk sales of Dr. Wherry's *Fern Guide*, from which we receive the royalties. The greatest jump in receipts over last year was in the sale of back numbers. Many individuals and libraries are becoming interested in obtaining complete sets of the Journal and receipts from sale of back numbers has more than doubled, to a new high of $1052.24 during 1962.

Because of the increased income from sale of back numbers, it is advisable for the Society to maintain as complete a run as possible, and any reasonable expenditure necessary to reprint short stocks should meet with approval.

The increased demand for back numbers, combined with the larger membership and involved correspondence that is necessary with subscribers, has further burdened the office of the Treasurer. Some reorganization may soon be necessary, to divide the duties presently encompassed in the office of Treasurer. Another alternative might be to elect to this office a retired banker or accountant who has skill and time to handle all of the duties incumbent upon this office. The Council would be happy to hear from any among our members who meet these qualifications.

Adoption of the constitutional amendment requiring payment of membership dues by the 15th of January each new year will permit the Treasurer to trim from the mailing list of the Fern Journal many members who would otherwise default their dues after another year, and as a consequence receive two years of

the Journal for the price of one. This is intended to affect only those who join, then after a year decide they no longer want the Journal, but neglect to resign from membership. The amendment was not intended to inconvenience the faithful members of the Society, who regularly send in their dues promptly. It also eliminates the necessity of sending out so many second notices, about 200 of which had to be dispatched last year. Second notices constitute a further unnecessary burden on the Treasurer.

A financial report for the year is presented below.

Receipts

	Amount	*Total*
Cash on hand, January 1, 1962		$ 602.92
Membership dues:		
Arrears	$ 42.60	
Renewals	1,289.03	
Sustaining	485.00	
New	226.27	
Advance		
New	42.10	
Renewal	91.55	
Life	50.00	
		2,226.55
Subscriptions:		
Arrears	17.90	
Current	327.15	
Advance	450.30	
		795.35
Sale of back numbers	1,052.24	
Sale of reprints	235.01	
Gifts	182.24	
Advertising	7.50	
		1,476.99
		$5,101.81

Disbursements

A. F. J. Vol. 51, No. 4	$ 828.28	
A. F. J. Vol. 52, No. 1	922.75	
A. F. J. Vol. 52, No. 2	675.21	
A. F. J. Vol. 52, No. 3	770.56	
		$3,196.80
Reprints	256.86	
Envelopes, stencils, postage	79.99	
Printing of stationery & invoices	31.42	
Packing & shipping back numbers	186.32	
Packing & shipping Treasurer's records	34.21	
Treasurer's expenses:		
Postage and mailing	108.40	
Bond	12.50	
Bookkeeping supplies	30.90	
Secretary's expenses	44.16	
Life membership fund	50.00	
		834.76
		$4,031.56
Cash in Industrial National Bank, January 1, 1963		$1,070.25

Statement December 31, 1963

Assets

Cash in Industrial National Bank	$1,070.25	
Cash in Greenpoint Savings Bank		
Bissell Herbarium Fund	781.96	
Life Membership Fund	1,053.47	
Reserve Fund	2,140.64	
Una Weatherby Fund	3,501.27	
Accounts Receivable	102.17	
Inventory—American Fern Journal	2,839.60	
Library	396.00	
		$11,885.36

Liabilities	
Advance dues collected	$ 133.65
Advance subscriptions collected	450.30
Accounts payable	
A. F. J. Vol. 52, No. 4	773.59
A.I.B.S. affiliate membership	100.00
	$1,457.54
Fund Balances	
Bissell Herbarium Fund	781.96
Life Membership Fund	1,053.47
Reserve Fund	2,140.64
Una Weatherby Fund	3,501.27
General Fund	2,950.48
	$11,885.36

Respectfully submitted, RICHARD L. HAUKE, *Treasurer*

Report of the Auditing Committee

I hereby certify that I have seen the books and accounts of Dr. Richard L. Hauke, Treasurer of the American Fern Society, Inc.. and have obtained confirmation of the correctness of the Society's balances on hand as set forth in detail in the accompanying Report of the Treasurer.

LUKE S. ALBERT, *Auditor*

Report of the Judges of Elections

In accordance with Art. V, Sect. 5, the Constitution of the American Fern Society, Inc., I submit the following report of the election of 1962:

Three hundred forty-two valid ballots were received. In addition, two ballots were returned from decedents and four were received after the election closed and are unopened. The tally of votes is as follows:

For President

Robert C. Lommasson	318
Donovan S. Correll	2
Warren H. Wagner, Jr.	2
F. W. Hunnewell	1
Elva Lawton	1

For Vice-President:

Donovan S. Correll	320
Robert C. Lommasson	2
F. W. Hunnewell	1
Warren H. Wagner, Jr.	1

For Secretary:

Lenette R. Atkinson	213
Frieda L. Wertman	95

For Treasurer:

Richard L. Hauke	323
F. W. Hunnewell	1

I therefore declare the following officers elected: Robert C. Lommasson, President; Donovan S. Correll, Vice-President; Lenette R. Atkinson, Secretary; Richard L. Hauke, Treasurer.

In accordance with Art. VII, Sect. 1, the Constitution of the American Fern Society, Inc., I submit the following report on the ratification of amendments:

A total of 342 ballots were validly cast. The tally of votes is as follows:

For the proposed amendment to Art. III, Sect. 8,

Yes ..... 304 No 26

For the proposed amendent to Art. IV, Sect. 1,

Yes ..... 319 No 14

I therefore declare that the proposed amendments have received more than two thirds of the votes cast and that more than twenty votes were cast and the amendments are ratified.

Respectfully submitted, DANIEL F. BURTON,
Judge of Elections

NEW MEMBERS

Miss Oneida Beeman, 7325 Willow Lane, Raytown 33, Missouri
Mr. Patrick J. Brennan, 6576 Telford Avenue, South Burnaby, British Columbia, Canada
Mrs. Samuel T. Brinton, 8210 Jenkintown Road, Elkins Park, Pa.
Mrs. Helene DeAndoin, 2706 E. Linwood Avenue, Turlock, Calif.
Mr. Ralph Deitrick, 4315 Farrell Road, Dexter, Mich.
Dr. Frances M. Jarrett, The Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey, England
Mr. Roger G. Kennedy, 10 Eagle Ridge Road, North Oaks, St. Paul 10, Minn.
Mr. James B. McFarlin, 410 34th Street West, Bradenton, Florida
Dr. Reid V. Moran, P. O. Box 1390, San Diego 12, Calif.
Miss Marie Sperka, Woodland Acres Nursery, R. 2, Crivitz, Wisconsin
Mrs. W. J. Waterson, R. R. 6, Box 204, Anderson, Indiana

CHANGES OF ADDRESS

Dr. David E. Blaydes, Dept. of Botany & Plant Pathology, Michigan State University, East Lansing, Mich.
Mr. Lionel Cinq-Mars, 489 Jean Dequen, Ste.-Foy, Quebec, Canada
Miss F. Jewell Coyne, Box 248, El Modena, Calif.
Mr. Thomas Darling, Jr., 3809 Larno Drive, Alexandria, Va.
Mr. Pierre C. Fischer, 501 Eddy Avenue, Missoula, Mont.
Mr. H. William Johansen, 1137-H 9th, Berkeley, Calif.
Dr. Gasper A. Loughbridge, 712 North 20th Place, Phoenix 6, Arizona
Mrs. Franz D. Nagel, 1670 Evergreen Avenue, Juneau, Alaska
Mr. Charles Neidorf, 1580 E. 22 Street, Brooklyn 10, N. Y.
Mr. James D. Perry, Department of Botany, Duke University, Durham, N. C.
Mrs. George Piternick, 9803 19th Avenue, N.E., Seattle 15, Wash.
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Mr. Alfred W. Roberts, Box 248, El Modena, Calif.
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Mr. John E. Schmitz, 602 Shroeder Lane, Grants Pass, Oregon
Miss Helen Tryk, 1605-A South 5th Street, Alhambra, Calif.

Suggestions to Contributors to the American Fern Journal

1. Authors of papers submitted to the *American Fern Journal* should consult the *Style Manual for Biological Journals* (1960) and be guided by its examples.

2. The "name-and-year" system for bibliographic references will, except in exceptional cases, be used. (See Literature Cited below for an example).

3. Authors are encouraged to use the journal abbreviations set forth by Schwarten and Rickett (1958, 1961).

4. Abbreviations of names of herbaria will be those listed by Lanjouw and Stafleu (1959).

5. Reports of chromosome numbers will not be accepted unless documented.

6. The use of footnotes and tabular matter should be kept to a minimum.

7. All manuscripts submitted for publication should be typed, double-spaced, and have ample margins.

8. Reprints should be ordered when galley proof is returned to the Editor. An order blank will be included with the galley proof.

Literature Cited

American Institute of Biological Sciences, Committee on Form and Style of the Conference of Biological Editors. 1960. Style Manual for Biological Journals. American Institute of Biological Sciences. Washington, D. C. 100 p.

Lanjouw, J., and F. A. Stafleu. 1959. The Herbaria of the World. Index Herbariorum, Regnum Veg. **15**: 1-249.

Schwarten, L., and H. W. Ricket. 1958. Abbreviations of Titles of Serials Cited by Botanists. Bull. Torrey Club **85**: 277-300; 1961. Supplement I. Ibid. **88**: 1-10.

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× **Lemoinei**	10.00	5.00
pumila, and **Hillii**, each	10.00	7.50
sumbawense, and **Veitchii**, each	10.00	7.50
grande	12.50	
Willinckii		7.50

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VOL. 53 APRIL-JUNE, 1963 NO. 2

American Fern Journal

A QUARTERLY DEVOTED TO FERNS

Published by the

AMERICAN FERN SOCIETY

IRA L. WIGGINS

C. V. MORTON ROLLA M. TRYON

JOHN H. THOMAS

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MISSOURI BOTANICAL

JUL 8 1963

The American Fern Society

Council for 1963

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DONOVAN S. CORRELL, Texas Research Foundation, Renner, Texas — *Vice-President*

LENETTE R. ATKINSON, 415 S. Pleasant Street, Amherst, Massachusetts — *Secretary*

RICHARD L. HAUKE, Department of Botany, University of Rhode Island, Kingston, Rhode Island — *Treasurer*

IRA L. WIGGINS, Dudley Herbarium, Stanford University, Stanford, Calif. — *Editor-in-Chief*

OFFICIAL ORGAN

American Fern Journal

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ROLLA M. TRYON
Gray Herbarium, Harvard University, Cambridge 38, Mass.
JOHN H. THOMAS—Dudley Herbarium, Stanford University, Stanford, Calif.

An illustrated quarterly devoted to the general study of ferns, published quarterly by the American Fern Society, 3110 Elm Ave., Baltimore 11, Md. Second-class postage paid at Baltimore, Md.

Matter for publication should be addressed to Ira L. Wiggins, Natural History Museum, Stanford University, Stanford, California.

Subscription $3.00, exclusive of agency handling fees; sent free to members of the American Fern Society (annual dues, $2.50; sustaining membership, $5.00; life membership, $50.00). Extracted reprints, if ordered in advance, will be furnished authors at cost, plus postage.

Back volumes $3.00 each; single back numbers 75 cents each; Cumulative Index to vols. 1-25, 25 cents. Ten per cent discount on orders of six volumes or more.

Changes of address, applications for membership, subscriptions, orders for back numbers, and other business communications should be addressed to the Treasurer, Dr. Richard L. Hauke, Department of Botany, University of Rhode Island, Kingston, Rhode Island. Members and subscribers should allow two months for changes in address to take effect.

LIBRARIAN AND CURATOR OF THE HERBARIUM

Dr. W. H. Wagner, University of Michigan, Ann Arbor, Mich.

A regular loan department is maintained in connection with the library and herbarium. Members may borrow books and specimens at any time, the borrower paying all postal or express charges. The pages of the Journal also are open to members who wish to arrange exchanges; a membership list is published at intervals, to assist those interested in obtaining specimens from different localities.

American Fern Journal

VOL. 53 APRIL-JUNE, 1963 NO. 2

Some West Indian Species of Thelypteris

C. V. MORTON

The West Indian, and especially the Continental, species of *Thelypteris* sect. *Lastrea* are little known, despite the careful studies of Carl Christensen. The primary difficulty is inherent —the very large number of species concerned. There are good characters for the species, in habit, size and cutting, venation, texture, pubescence, and sori, but scarcely any guide as to which characters are more significant than others. Most of the characters seem to be varying independently, but detailed studies might show correlations that would be taxonomically significant.

Christensen's key is unusable in practice, for it is fundamentally based on size. The primary division is "Tertiary veins 1-10-jugate" as compared with "Veins 12-25-jugate." It will be noted that there is no place for the plants with the veins 11-jugate! It is not, as would be theoretically possible and as might be envisioned from the key, that one species with segments 10 mm. long would have 5 pairs of veins and another species with segments of the same length 15 pairs, in other words the veins being distant in some and close in others; there is some variation in the distance of the veins, it is true, but not a great deal, and in any case this has not been studied. (If it were, the proper way to express it would be by giving the number of veins per centimeter rather than the number per segment.) No. the number of pairs indicated by Christensen depends primarily not on the distance of the veins from each other but on the total length of the segments, and thus in turn on the size of the plant. Under the first division of

Volume 53, No. 1, of the JOURNAL, pp. 1-56, was issued April 11, 1963.

Christensen we find another major division: "Pinnae rarely more than 1.5 cm. broad, 10 cm. long," opposed to "Pinnae 2-5 cm. broad, 10-15 cm. long." Again what becomes of the plants with pinnae 1.5-2 cm. broad, which certainly exist? Like most characters depending on absolute size these are unreliable. Extreme specimens, either large or small, can be placed without difficulty, but a great many specimens fall somewhere in between and have to be searched for under two or three different arms of the key.

Another character emphasized by Christensen in the key is "Pinnae chartaceous-membranaceous" as opposed to coriaceous, subcoriaceous, or rigidly papyraceous. Aside from differences occasioned by young as opposed to mature or old plants and by methods of drying, texture is a truly subjective thing. Some species that Christensen keys as papyraceous I should call "chartaceous-membranaceous" and vice versa, and who is to decide which is correct, and would any such decision be meaningful to another botanist called upon to decide himself? Very likely texture, depending as it must on the number and structure of the leaf-cells, can some day be defined objectively on the basis of histological studies, but at the present time its use vitiates the usefulness of Christensen's key. The same can be said, to a lesser degree, of another major character stressed by Christensen—the base of the blade, whether gradually or abruptly attenuate, and the number of reduced basal pinnae. In his paper "Revision of the American Species of Dryopteris of the Group of *D. opposita*" he gives on page 254 diagrams of five possible types, but unfortunately the plants do not always fit in with the diagrams. It is true that many species do definitely and always fall into one type, but there are plenty of others that are difficult to place, being intermediate between two or more of the types.

There is one obvious character of many West Indian species, namely the presence of large, sessile, globular, red glands on the lower leaf-surface and on the indusia. I give a tentative key below to these species. I do not mean to imply that this character is more important than others or that these species are necessarily more closely related to each other than to others, although it *may*

be so. Certainly these glands are peculiar and they may indicate a real relationship. On the other hand they may have arisen independently along several lines of evolution in response to some particular function, as yet unknown. The latter possibility seems more probable, because there is one species, *Thelypteris Thomsonii*, which has them and which may be unrelated; at least it is currently referred to a different section, *Glaphyropteris*, although admittedly on the basis of a single character—the presence of aerophores at the bases of the costules. In any case, these glands are a definite character—they are either present or not present, and thus they are usable in a key. I do not know any species in which these glands are sometimes present and sometimes not, but sometimes they are very few and must be searched for carefully.

KEY TO WEST INDIAN THELYPTERIS, SECT. LASTREA, WITH RED GLANDS

Sporangia strongly setose; red glands on lower surface few or perhaps sometimes lacking but always obviously present on the indusium; rhizomes long-creeping ..... *T. firma* (Baker) Proctor

Sporangia lacking setae; red glands always present on lower surface although sometimes few; rhizomes erect.

Indusia red-glandular, not pilose.

Costules beneath, at least toward base, with obvious clathrate scales. Margins recurved, more or less covering sori. *T. cheilanthoides* (Kunze) Proctor

Costules scaleless beneath.

Rhachis glabrous, even along the groove above, more or less stipitate-glandular. Stipe scales glabrous on the back, not ciliate; both upper and lower surfaces glabrous; costae beneath essentially glabrous, sometimes sparsely stipitate-glandular; prominent knoblike or elongate aerophores present at base of pinnae beneath.

Sori submarginal, borne on the several, rounded, recurved lobes of the segments ..... *T. limbata* (Swartz) Proctor

Sori supramedial or if submarginal not borne on marginal lobes. *T. malangae* (C. Chr.) Morton

Rhachis pilosulous or villous, at least along the groove above, stipitate-glandular or not. Lower surface glabrous.

Rhizome and stipe scales bearing hairs on the outer surface and also ciliate. Delicate, small (pinnae not more than 2.5 cm. long) plants, with long, slender stipes (mostly 10-17 cm. long to the lowest depauperate pinna) ..... *T. glutinosa* (C. Chr.) Morton

Rhizome and stipe scales glabrous, not ciliate.

Blades coarse, the rhachis mostly 3-5 mm. thick on mature fronds, the segments broadly oblong, 3 to (rarely) 4 times as long as broad, mostly 3-5 mm. wide at the middle. Segments not auriculate; some minute, linear, pale scales sometimes present on the rhachis above but clathrate, dark-walled scales absent ..... *T. pachyrachis* (Kunze) Ching

Blades more delicate, the rhachis mostly 2-3 mm. thick, the segments narrowly oblong, usually 4.5-6 times as long as wide, mostly 2-2.5 mm. wide, at the middle. Clathrate, dark-walled scales present on the rhachis above at the bases of the pinnae, these sometimes deciduous.

Proximal basal segments of the pinnae auriculate on the lower side, the auricle overlapping the rachis on the upper (ventral) side and not visible from the fertile (dorsal) side; upper leaf-surface without large, sessile, red glands or stipitate glands; **rhachis short-pilosulous.**[1]

***T. balbisii* (Spreng.) Ching**[2]

Proximal basal segments not auriculate; upper leaf-surface with large, conspicuous, sessile, globular, red glands similar to those of the lower surface, and also minute, white, stipitate glands; rhachis beneath pilosulous and also with some very long, lax, spreading, many-celled hairs.

***T. randallii* Maxon & Morton**

Indusia, if present, pilose as well as red-glandular.

Pinnae with 14 pairs of segments or usually fewer, strongly unequal-sided; rhizome and stipe scales bearing red glands on surface and

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[1] Occasional specimens of *T. resinifera* and *T. opposita* with few or no hairs on the indusia would be sought here. They differ in having the segments shorter (1.5-3 times as long as broad), the rhachis without scales above, the pinnae often somewhat unequal-sided and of a linear-lanceolate type, the basal segments being the largest and the others gradually reduced in size upwardly. In *T. Balbisii* and *T. Randallii* the pinnae are of a linear-oblong type, the segments being all much the same size from the base to about the middle of the pinnae or even higher.

[2] *Dryopteris Sprengelii* var. *longipilosa* C. Chr. (isotype US) is known insufficiently from sterile material only. It differs in having the rhachis and costae beneath long-pilose with lax, many-celled hairs, and may not be conspecific.

margins; lowest basal segment of the pinnae usually borne at almost a right angle with the rhachis.

Indusia large, subathyrioid (unequal at base, one side extending down the vein), sparingly pilose; sori submarginal usually.

T. consanguinea (Fée) Proctor

Indusia absent or if present small, apparently not athyrioid, obviously pilose; sori intramarginal ..... *T. sancta* (L.) Ching

Pinnae with 18 pairs of segments or more, or if fewer pinnae equal-sided or only slightly unequal-sided; rhizome and stipe scales eglandular; lowest basal segment of the pinnae parallel to the rhachis or descending at less than a right angle.

Rhachis with numerous, minute, spreading, one-celled hairs mixed with elongate, several- or many-celled hairs; stipe scales ciliate and bearing some hairs on the back surface; pinnae slightly if at all unequal-sided.

Veins of upper surface with minute, stiff hairs 0.3 mm. long or less; costae beneath densely short-puberulous, the hairs 0.2-0.3 mm. long ..... *T. Nockiana* (Jenm.) Proctor

(incl. *Dryopteris scalpturoides* var. *jamaicensis*)

Veins of upper surface hirsutulous, the hairs setiform, 0.5 mm. long or more; costae beneath pilose, the hairs often 0.5 mm. long.

T. Underwoodiana (Maxon) Ching

Rhachis with a uniform pubescence, the hairs all approximately the same size.

Rhachis and costae beneath minutely puberulous, the hairs mostly 0.2 mm. long or less; rhizome and stipe scales with some hairs borne on the outer surface; basal dwarfed pinnae 1-4 pairs.

T. piedrensis (C. Chr.) Morton

Rhachis and costae beneath pilosulous, the hairs much more than 0.2 mm. long; rhizome and stipe scales glabrous on the back.

Scales at base of stipe clathrate, the cells broad, often as broad as long; indusia obviously long-pilose.

T. caribaea (Jenm.) Morton

Scales at base of stipe subfibrous, the cells elongate, several times as long as broad; indusia finely and often indistinctly pilose.

Segments short and broad, usually 1.5-2 times as long as broad; pinnae, if unequal-sided, with the proximal segments longer than the distal. ..... *T. opposita* (Vahl) Ching

Segments longer, 2-2.5 times as long as broad or occasionally even a little longer; pinnae, if unequal-sided, with the proximal segments shorter than the distal.

T. resinifera (Desv.) Proctor

THELYPTERIS BALBISII (Spreng.) Ching, Bull. Fan Mem. Inst. Biol. Bot. **10**: 250. 1941.

Polypodium Balbisii Spreng. Nov. Act. Acad. Caes. Leop. Carol. **10**: 228. 1821.

Aspidium Sprengelii Kaulf. Flora **6**: 365. 1823. Based on *Polypodium Balbisii* Spreng. *Nom. abort.*

Dryopteris Sprengelii Kuntze, Rev. Gen. Pl. **2**: 813. 1891. Illegitimate, because earliest available epithet was not adopted.

Dryopteris Balbisii Urban, Symb. Antill. **4**: 14. 1903.

Thelypteris Sprengelii Proctor, Bull. Inst. Jam. Sci. Ser. **5**: 65. 1953. Illegitimate.

In recent years, a characteristic large species, with many pairs of opposite pinnae, these with many pairs of segments, these entire and obviously ciliate, has been known as *Dryopteris Sprengelii* (Kaulf.) Kuntze. Urban correctly took up the name *D. Balbisii* (Spreng.) Urban (based on *Polypodium Balbisii* Spreng.) and was followed by Christensen in the Index Filicum (1905), but later Christensen (Dansk. Vid. Selsk. Skrift, VII, **4**: 296. 1907) "according to an identification by Prof. Hieronymus" reduced Sprengel's species to *Dryopteris sancta* (L.) Kuntze var. *Balbisii* (Spreng.) C. Chr., the plants referred to it being actually a form of the polymorphic species *D. sancta*, and took up for the species previously known as *D. Balbisii* the name *D. Sprengelii* (Kaulf.) Kuntze. Later, Christensen (Repert. Sp. Nov. Fedde **15**: 24. 1917, and *op. cit.* VIII, **6**: 17. 1920) indicates that he himself saw a Bertero specimen in Berlin that he took to be the type of *Polypodium Balbisii* Spreng. and found it to be a variety of *D. sancta*. But this treatment is in error on two counts.

Polypodium Balbisii Sprengel was described from material collected in Puerto Rico by Bertero (misspelled Bertier by Sprengel). The original description, which is in a publication not everywhere available, is reproduced below:

"4. Polypodium Balbisii. P. fronde bipinnatifida, subtus resinoso-punctata, pinnis oppositis sessilibus approximatis lanceolatis horizontalibus acuminatis, laciniis lanceolatis obtusiusculis integerrimis ciliatis, infimis

appressis longioribus, soris marginalibus seriatis, stipite villoso.

"In insula Portorico. *Bertier.*

"P. sanctum Sw., pro quo habitum fuit, longissime differt: 1) stipite glabro, 2) pinnis laciniisque remotis, his linearibus crenulatis, margine haud ciliatis, 3) soris marginalibus quidem, sed ad apicem usque seriem unam formantibus. In nostro vero laciniae approximatae, integerrimae, lanceolatae, obtusiusculae, ciliatae, subtus punctis resinosis aureis conspersae. Sori marginales a sinubus inde ad mediam laciniam ascendunt, nec ultra.

"P. hirsutum Sw. Act. holm. 1817, p. 61. differt laciniis ovatis dentatis utrinque pilosis.

"Aspidium patens Sw. simillimum etiam laciniis infimis elongatis, differt tamen: 1) his ipsis laciniis pinnatifido-incisis, 2) venis subtus hirtis, 3) indusio umbilicali, quod hic ab est."

This description clearly shows, in the characters of opposite, approximate, horizontally spreading pinnae, with entire ciliate segments, the lowest the longest, and the villous stipe, that it agrees wholly with the plant currently known as *D. Sprengelii*, and not with *D. sancta*. In fact, Sprengel, as shown above, compares his species with *sancta*, correctly except in the character of the sori going to the apex of the segments in *sancta* and only to the middle in *Balbisii*, which is not a character useful in distinguishing either species; evidently Sprengel's specimen of *Balbisii* was only partially fertile, which is not at all rare in this species. Sprengel's comment that *Balbisii* is extremely similar to *Aspidium patens* is also significant, for *Dryopteris patens* is superficially similar to *D. Sprengelii* but not at all to *D. sancta*. It is evident that the Bertero specimen seen in Berlin by Hieronymus and later by Christensen is truly *D. sancta*, but that this specimen is not the type of *Polypodium Balbisii* Spreng. Sprengel's herbarium was dispersed after his death and so the location of the actual type is uncertain, but his species is clearly identifiable from the description.

The second error of Christensen is in taking up the epithet *Sprengelii*. Kaulfuss' treatment (Flora **6**: 365. 1823) is as follows:

"Aspidium sprengelii Kaulf. A. frondibus pinnato-profunde pinnatifidis, pinnis oppositis sessilibus horizontalibus, laciniis oblongo-lanceolatis obtusiusculis integerrimis ciliatis, infimis longioribus, basilari pinnarum in-

feriorum deorsum spectante subauriculata, soris submarginalibus, indusiis hirtis margine glandulosis. Polypodium Balbisii Spreng. manip. in act. acad. C. L. C. 10. 1. p. 228."

It is clear that Kaulfuss was merely renaming *Polypodium Balbisii* Spreng. in transferring the species to the genus *Aspidium*, a not uncommon custom at that time, a hundred years ago and more, in which rules of nomenclature were hardly in existence. He not only cited Sprengel's name as an unequivocal synonym but took his own specific epithet from Sprengel's name, and his description is actually only a modification of Sprengel's original description with some additions from the specimen that he had in hand, *Sieber* 355. The only real addition is the description of the indusium, which Sprengel had failed to see, not surprisingly since this is minute in this species and often deciduous. The name *Aspidium Sprengelii* Kaulf. was therefore superfluous when published and illegitimate.

The restoration of the name by Ching in publishing *Thelypteris Balbisii* (Spreng.) Ching was in a sense accidental. Ching was publishing a large number of new combinations in *Thelypteris* and other genera in a purely bibliographic way, going on the entries in the Index Filicum, in which *Dryopteris Balbisii* (Spreng.) Kuntze had been recognized as a valid species. There is no evidence that Ching had seen the original descriptions or had studied the species in any taxonomic way.

The transfer of the application of the epithet *Balbisii* back to another species would seem to leave the Puerto Rican variety of *T. sancta* without a name. Christensen attempted to keep his variety *Balbisii* distinct from *Aspidium sanctum* var. *portoricense* Kuhn, but it differs chiefly in pubescence and I am not convinced of its taxonomic validity. For the present all the Puerto Rican forms of the species may be known as:

THELYPTERIS SANCTA (L.) Ching var. **portoricensis** (Kuhn) Morton, *comb. nov.*

Aspidium sanctum var. *portoricense* Kuhn, Bot. Jahrb. Engler **24**: 115. 1897.

THELYPTERIS **caribaea** (Jenman) Morton, *comb. nov.*

Nephrodium caribaeum Jenman, Journ. Bot. Brit. For. **24**: 270. 1880. Type: Jamaica, without specific locality, *Sherring* (K, photograph US; isotype, US).

Dryopteris caribaea C. Chr. Ind. Fil. 257. 1905.

Christensen, in his monograph of *Dryopteris*, reduced this to the synonymy of *D. panamensis*, i.e. *Thelypteris resinifera*, but this is incorrect, as shown by an isotype in the U. S. National Herbarium and a photograph of the type at Kew, which agrees with the isotype. It is a more delicate plant than *resinifera*, with a minutely but rather densely and uniformly puberulous rhachis beneath, with densely and obviously pilose indusia, and with stipe scales with broad cells not much longer than wide. In *T. resinifera* the rhachis is glabrescent beneath, the indusia scarcely if at all pilose, and the stipe scales are fibrous, i.e. with elongate cells with narrow lumina. A much nearer relationship of *T. caribaea* is with *T. Underwoodiana*, which has similar indusia and scales, but a different, coarser pubescence on the rhachis and longer, coarser hairs on the veins above.

Jenman did not understand his own *N. caribaeum* well because the specimens so labelled by Jenman himself in the Hope Gardens Herbarium are not the same as the type. A sheet numbered "J.P. 167" is a mixture; the right-hand specimen has been identified by Maxon as *Dryopteris Nockiana* (Jenm.) C. Chr., doubtless correctly, as Dr. Maxon knew this species very well; the left-hand specimen, from a photograph and a single pinna, I identify as *T. Underwoodiana*. A second sheet of "J.P. 167" also bears two specimens, one with a large rootstock mounted at the middle of the left-hand side of the sheet; this sheet may have the same mixture of species as the other one or it may be all *T. Underwoodiana*; I'd have to see more than a photograph to be sure. The sheet in the Hope Gardens Herbarium bearing the number "J.P. 310" has three specimens on it; the two top specimens are obviously *T. sancta*; the bottom specimen is doubtful to me, but it could be *T. caribaea*, although I should want to examine it to make sure.

for photographs in these closely allied species are not altogether satisfactory.

THELYPTERIS **glutinosa** (C. Chr.) Morton, *comb. nov.*

Dryopteris glutinosa C. Chr. Svensk. Vet. Akad. Handl. III, **16**^{2}: 18. 1937. Type: Torbec, Morne Formon, Haiti, *Ekman* H 7500 (isotype, US).

THELYPTERIS **malangae** (C. Chr.) Morton, *comb. nov.*

Nephrodium jenmanii Baker var. *sitiorum* Jenm. Journ. Bot. Misc. Inf. **17**: 261. 1879. Type: "No. 40, Herb. Kew, 1878." Later (Bull. Bot. Dept. Jamaica, n.s., **3**: 46. 1896), Jenman referred this, under the name *Nephrodium sitiorum* (combination unpublished as a species except in synonymy), to *Nephrodium conterminum* Desv. For locality of *N. conterminum*, Jenman cited only Moody's Gap, 4000 feet. This indicates that a specimen (US) from the Jenman Herbarium saying "Type Specimen-Collected 1874-79" and labelled *Aspidium conterminum* from Moody's Gap, 4000 feet, is an isotype of var. *sitiorum*.

Dryopteris consanguinea var. *aequalis* C. Chr. Smiths. Misc. Coll. **52**: 380. 1909. Type: Second Breakfast Spring, near Tweedside, Jamaica, alt. ca. 2000 feet, on open grassy bank, April 13, 1903, *Maxon* 997 (US). A specimen, essentially an isotype, collected with Maxon at the same time and place is *Underwood* 2131 (NY).

Dryopteris malangae C. Chr. Svensk. Vet. Akad. Handl. III, **16**^{2}: 21. 1937.

Rhizome erect, slender, ca. 3 mm. in diameter without the stipe bases; rhizome scales brown, few and not easily observable as to size and shape, apparently rather large and broad, long-attenuate, apparently glabrous, the cells large, elongate, averaging ca. 200 μ long and 50 μ wide, the walls thin, light brown, the lateral walls colorless; fronds erect, numerous, fasciculate, 50-80 cm. long, the stipes thick, 2-4 mm. in diameter, stramineous, glabrous, hardly scaly, very short, 3-8 cm. to first aborted pinnae; blade ovate-oblong, ca. 45-75 cm. long, ca. 20 cm. wide, rather shortly acuminate at apex, gradually reduced toward base, the rhachis stramineous, ca. 1 mm. thick near middle, the channel above with rounded sides, sometimes rather shallow,

scaleless, not hairy, provided rather abundantly with minute, white, capitate glands; pinnae sessile, rather distant, the intervals between the principal pinnae 2-3.5 cm., 30-35 pairs including the adnate upper segments and the dwarf basal ones, well-developed pinnae ca. 18-23 pairs, the lower and middle subopposite, those of the upper third alternate, widely spreading or slightly ascending, linear-lanceolate, the largest middle ones ca. 10 cm. long and 1.7 cm. wide near base, gradually and slenderly long-acuminate, broadest at base, equal-sided, pinnatifid, the segments ca. 20 below the subentire caudate apex, united by a narrow wing 1 mm. wide, oblong, the basal ca. 10 mm. long and 3 mm. wide, the proximal basal one the largest, this auriculate at base, the auricle overlapping the rhachis on the upper side, and sometimes lobed above base, the middle 6-9 mm. long and 3 mm. wide, rounded at the apex and here slightly toothed with 2 or 3 low rounded teeth, nearly symmetrical, the distal base slightly broader than the proximal, herbaceous in texture, the costa raised above and deeply sulcate, sparsely provided with minute (scarcely 0.2 mm. long), colorless, acute, acicular hairs, the costules slightly sulcate and hairy like the costae, the surface shining, glabrous, the costae beneath raised, rounded, scaleless, not hairy, bearing a few stalked glands, the costules scaleless, glabrous and apparently lacking stalked glands, curved at base and decurrent on costa, provided with conspicuous, red, sessile, globular glands ca. .05 mm. in diameter, the veins 6 to 9 pairs straight, unforked (except the basal veins on the proximal side of the basal pair of segments), reaching the margins well above the sinuses, not hairy, conspicuously red-glandular like the costules, the surfaces glabrous, sparsely red-glandular, the margins minutely ciliolate; lowest pinnae reduced to mere auricles and ultimately knobs; small knoblike aerophore present at base of the costae beneath; sori 4 or 5 pairs, conspicuous, supramedial; indusia conspicuous, subrotund ca. 2 mm. long and wide, cordate at base, one basal lobe longer than the other and extending down the vein, persistent, glabrous, bearing conspicuous, sessile, red, globular glands on the margins and sparingly on the surface; annulus 11-14-celled; spores all well-formed and uniform, bean-shaped, bilateral, 38-43 μ long, 25-28 μ wide, without spines or processes, any crests if present very minute.

TYPE: Crête à Piquants, Morne Malanga, Massif de la Selle, Haiti, 1200 m., Apr. 20, 1926, *Ekman* H 5889 (isotype US).

ADDITIONAL SPECIMENS EXAMINED:

HISPANIOLA: Moneión, Río Cenobicito, Prov. Monte Cristi, Dominican Republic, 800 m., June 22, 1929, *Ekman* H 12962 (US). San José de Ocoa, Loma del Rancho, Sierra de Ocoa, Prov. Azua, Dominican Republic, 1200 m., Feb. 23, 1929, *Ekman* H 11625 (US).

JAMAICA: *Sin. loc., Wilson* 749 (K, Photo US) (labelled by Jenman *N. sitiorum*). Mount Moses, Mar. 28, 1899, *Harris* 7582 (Hope Gard., K, Photo US). *Sin. loc., J. P.* 370 (Hope Gard.).

CUBA: Arroyo Jiménez, in gravel of river, Sierra Maestra, Oriente, 600-900 m. alt., Aug. 9, 1922, *Ekman* 14819 (US) (slightly divergent in its darkish brown, rather than stramineous, rhachis and distinctly supramedial sori; more Cuban material will be needed to see if these characters are consistently present).

There does not appear to be any specimen either at Kew or in Jenman's herbarium at Hope Gardens, Jamaica, that represents Jenman's concept of *Nephrodium limbatum* Desv. (Jenman, *loc. cit.* 46, 47). It is possible that his description and comments are based on specimens from the Lesser Antilles rather than on Jamaican collections; at least, there are no Jamaican specimens of *T. limbata* at Kew or in the U. S. National Herbarium.

Christensen's reference of this species as a variety of *Dryopteris consanguinea* is hardly to be maintained. The characters differentiating it are too numerous and important to be only varietal. Actually, *Thelypteris consanguinea*, of which I have seen authentic material [Guadeloupe, *Herminier* 154 (GH)], by its general characters, especially by its unequal-sided pinnae, is much more closely allied to *T. sancta* than to *T. malangae*. The specimen from the Lesser Antilles (Mount Felix, Grenada, *Eggers* 6036 (US)) that Christensen referred to *D. consanguinea* var. *aequalis* is by no means the same as the Jamaican type; it is a large specimen of *T. opposita*.

The following key will distinguish the four species mentioned above. These are not necessarily closely allied; they are species that may have been confused in Jamaican material.

Pinnae very numerous, 40-55 pairs or more, close, the intervals between them less than 2 cm. and often less than 1 cm.; stipe and rhachis obviously pilose; veins few, 2-4 pairs. Costules and veins obviously hairy above. *T. opposita* (Vahl) Ching

Pinnae fewer than 35 pairs, rather distant, the intervals between them 2.5-4 cm. long (except in *T. consanguinea*); stipe and rhachis glabrous, sometimes sparsely stipitate-glandular; veins few to several.

Sori submarginal, borne on minute rounded lobes of the segments; plants large, the well-developed segments 10-12 mm. long. Costules and veins above with some hairs. ..... *T. limbata* (Swartz) Proctor

Sori supramedial or submarginal but not borne on small lobes; plants small to medium, the largest middle segments of the pinnae not more than 9 mm. long.

Blades small, not more than 35 cm. long; pinnae fewer than 20 pairs, the intervals between them usually 1 cm. long or less, strongly unequal-sided, the distal segments much larger than the proximal; costules and veins above with some hairs; veins 2 to 5 pairs; sori usually submarginal; indusia with some few acicular hairs.

T. consanguinea (Fée) Proctor

Blades larger, 50-80 cm. long; pinnae 30-35 pairs (including the small apical and basal ones), the intervals between them normally 2-3.5 cm. long, equal-sided; costules and veins above not hairy; veins 6 to 9 pairs; sori supramedial but not submarginal; indusia not hairy.

T. malangae (C. Chr.) Morton

THELYPTERIS **piedrensis** (C. Chr.) Morton, *comb. nov.*

Dryopteris piedrensis C. Chr. Smiths. Misc. Coll. **52**: 372. 1909.

Type: Gran Piedra, Oriente, Cuba, *Maxon* 4041 (US).

THELYPTERIS **Randallii** Maxon & Morton, *sp. nov.*

Rhizoma terrestre breve erectum ca. 5 mm. diam. sine stipitium basibus, paleis brunneis lanceolatis 4-5 mm. longis acuminatis integris glabris cellulis elongatis 0.2-0.25 mm. longis parietibus suberassiusculis brunneis luminibus magnis transparentibus; folia 30-50 cm. longa erecta fasciculata, stipitibus 1.5-2.5 mm. crassis brevibus, 3-5 cm. longis usque ad pinnulam basalem auriculiformem, stramineis juventute pilosulis, pilis patentibus ca. 0.25 mm. longis hyalinis demum decidentibus, persistenter paleatis, paleis patentibus eis rhizomatis similibus; foliorum laminae ovato-lanceolatae usque ad 43 cm. longae, 14-16 cm. medio latae, apice breviter acuminatae, basin versus subabrupte decrescentes, pinnulis 2 vel 3 paribus basalibus auriculiformibus, rhache tenui ca. 1 mm. diam., supra canaliculata pilosula et parce longe laxeque pilosa, pilis tenuibus multicellularibus, capitato-glandulosa, epaleata; pinnae ca. 23-28-jugae infra apicem pinnatifidum, omnes apicales excepti suboppositae, sessiles, subaequilaterales lineari-lanceolatae, 4.5 × 1.1 cm. usque ad 9 × 1.5 cm., apice longe acuminatae apice ipso subintegro, basi latissimae, alte pinnatifidae, segmentis 14-22 infra apicem pinnatifidum, oblongis, confertis, basi non auriculatis, sinubus angustis, majoribus 6 mm. longis et basi 2.5 mm. latis usque ad 9 mm. longis et 3 mm. basi latis, medio ca. 2 mm. latis, omnibus usque ad medium pinnarum subaequilongis, ala costali ca. 1 mm. lata, integris apice rotundatis, tenuiter herbaceis, supra in costa valde canaliculata perspicue pilosulis, secus canalem juventute parce paleatis, parietibus paleae fuscis, pilis minutis rigidis 0.3-0.4 mm. longis acutis hyalinis patentibus unicellularibus, in superficie praecipue marginem versus et in marginibus similiter pilosulis, et minute capitato-glandulosis, etiam glandulis rubris globosis magnis sessilibus dissitis praeditis, subtus in

costa elevata rotundata parce capitato-glandulosa epaleata parcissime pilosulis, costulis et venulis parce pilosulis, in venulis et superficiebus pulchre glandulosis, glandulis magnis sessilibus rubris globosis, superficiebus glabris, venulis 7-9-jugis simplicibus marginem attingentibus; sori 3-5-jugi, paullo supramediales parvi; sporangia pauca magna non setosa, annulo ca. 14 articulato; indusia parva reniformia persistentia glabra margine valde rubro-glandulosa; sporae fabiformes bilaterales 36-40 μ longae, 23-26 μ latae, non echinatae, superficie minutissime reticulatae.

Type in the U. S. National Herbarium, No. 1,182,586, collected in rocky bottom at edge of stream in a deep ravine in mountain forest above House Hill, St. Thomas Parish, Jamaica, at 500-700 meters elevation, June 6-12, 1926, by William R. Maxon (No. 9068) (also an isotype, US 1182585).

Named in honor of Mr. C. E. Randall, at whose home "House Hill" Dr. Maxon was a guest in 1926.

Dr. Maxon referred a plant collected in Jamaica by O. Hansen in 1897 (Herb. C. Chr. 620, now presumably in the British Museum) to this species. I have seen some detached pinnae only, but I feel doubtful if it does represent this species. It seems rather to be a small plant of *T. Balbisii*, to which the present species is indeed closely similar. The principal characters distinguishing the present species from *T. Balbisii* are the presence of large sessile globular red glands on the *upper* leaf-surface as well as the lower (a character not found in any other species of this group so far as I know), the presence of white, stipitate glands on the upper surface, the somewhat coarser and longer hairs along the channel of the costae above, and the absence of a basal auricle on the lower side of the basal segments of the pinnae.

SMITHSONIAN INSTITUTION, WASHINGTON, D. C.

See announcement about 1963 Fern Foray on page 92.

Plan to attend Summer Meetings of AIBS at Amherst, Mass. Aug. 26-31.

[This paper was written before the policy of decapitalizing species named for a person was announced. Mr. Morton suggested decapitalization after the material was in galley proof, but the cost of making the numerous changes seems unwarranted. Editor]

Ferns of Manitoulin Island, Ontario

JAMES H. SOPER

(*Continued from page 40*)

PTERIDACEAE

7. PTERIDIUM AQUILINUM (L.) Kuhn var. LATIUSCULUM (Desv.) Underw. ex Heller—In open rocky woods, McKim's Beach, 14 Sept. 1961, *S 9332*. Sight records: Barrie Is., Bluejay Creek, Cape Robert, Christina Bay, Cook's Dock, Dean Bay, Evansville, Frechette Bay, Gore Bay, Green Bay, High Hill, Honora, Ice Lake, James Bay, Kaboni, Manitou Lake, 5 & 8 miles SW of Manitowaning, Marsh Lake, Mindemoya, Mississagi Strait, Mud Lake, Perch Lake, Poole Lake, Providence Bay, Roberts Bay to Thomas Bay, Silver Lake, Silverwater, Sounding Cove, South Baymouth, West Bay, Windfall Lake; Cockburn Is.; Great, Outer, and Western Duck Islands; Baie Fine; Killarney.

Bracken occurs almost everywhere in the district and is abundant. Other collections: Providence Bay, Wekwemikongsing, and Cockburn Is., *C. O. Grassl 5859, 5877 & 5879* (MICH); 2 miles NW of Manitowaning, *H. H. Brown 5579* (TRT); Fossil Hill, *K. K. Irizawa 134* (TRT).

8. CRYPTOGRAMMA STELLERI (S. G. Gmel.) Prantl—On rocks of escarpment overlooking West Bay, 26 July 1956, *S & F 6607*; rock face of wooded ridge, Mud Lake, 5 July 1957, *S & G 7164*; mossy crevices of limestone in shady woods 8 miles SW of Manitowaning, 7 June 1959, *S & H 8444*; mossy crevices of limestone cliffs at top of escarpment, 1 mile N of Green Bay, 15 July 1959, *S & H 8779*; crevices of limestone cliff, East Bluff, 1 mile NE of Gore Bay, 24 July 1959, *S & H 8973*. Sight records: Cook's Dock, Evansville, Ice Lake, Manitowaning, Michael Bay, Mindemoya.

The Slender Cliff-brake is locally abundant on cliff faces and shaded limestone ridges. Other collections: Gore Bay, Battery Bluff and near Rattlesnake Harbour, *C. O. Grassl 1517, 1636, & 5889* (MICH); High Falls, *Pease & Ogden 25059* (GH, TRT); 2 miles N of Murphy Point, *Senn & Lindsay 5437* (DAO, TRT). Reported from McLeod Harbour on Cockburn Island by Bell (1870), as *Allosorus gracilis*; the specimen which I have seen from Bell's collection at Carleton University (CCO), labelled "Manitoulin Is." may have been taken on Cockburn Island.

9. ADIANTUM PEDATUM L.—I have seen the Maidenhair Fern on Manitoulin Island only once, in woods along the Manitou River near Michael Bay on 28 July 1952, in company with John Clayson. Since this species is common in most of Southern Ontario (Fig. 2) no voucher was taken at that time. Its rarity on the island was realized only later when the data were being examined for the preparation of this paper. I have also seen a specimen from a garden in Gore Bay to which the fern was said to have been trans-

planted from woods on the sixth concession of Mills Township, near Wolsey Lake. This fern has been found by Mr. W. D. Murray of Sheguiandah in woods around Bass Lake, just west of Sheguiandah.

Collections seen: Tehkummah Tp., *K. K. Irizawa 74* (TRT): this collection may have been made in the vicinity of Michael Bay, where this species has been seen also by Mrs. Roy Williamson of Mindemoya; lot 1, conc. IX, Dawson Tp., *P. Dean* (OAC #31664).

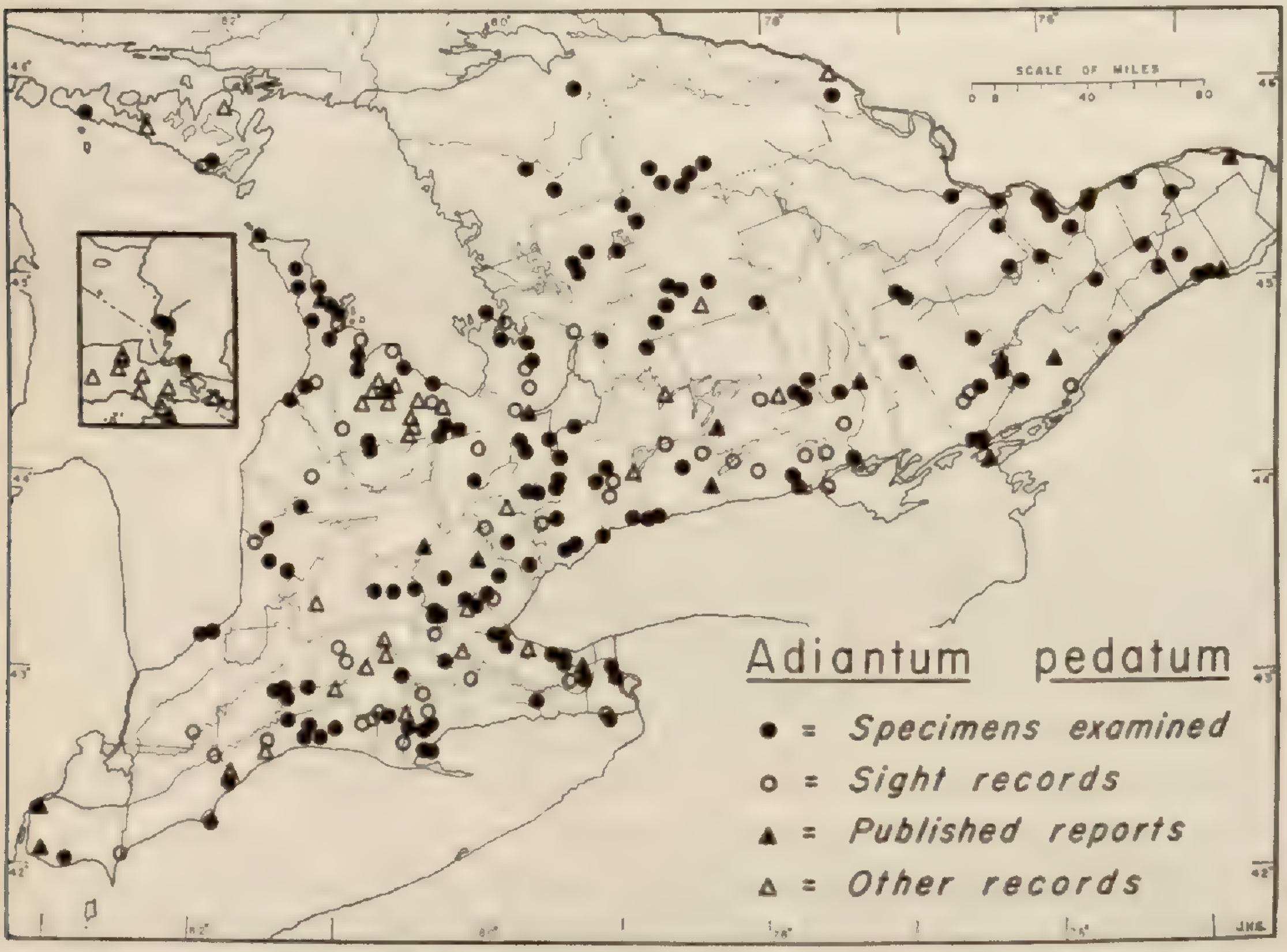


FIGURE 2. DISTRIBUTION OF ADIANTUM PEDATUM IN SOUTHERN ONTARIO. INSET SHOWS RECORDS FOR ADJACENT PORTIONS OF ALGOMA DISTRICT AND NORTHERN MICHIGAN.

10. PELLAEA ATROPURPUREA (L.) Link—In crevices of open limestone pavement, NW of Silver Lake (just N of Ontario Paper Company's Ranger Station), 20 July 1959, *S & H 8907*; crevices of large limestone boulders on talus slope, E side of High Hill on W side of Manitou Lake, 12 Sept. 1961, *S & Co 9301*. Sight records: Portage Bay, E side of Windfall Lake.

This species is rare in widely separated areas but in at least two cases I have found it locally abundant. It occupies more xeric habitats than the closely related *P. glabella* and the two species are not found growing together. The easternmost record on Manitoulin Island is based on a specimen

seen from Leask Bay, *W. Koelz 4152* (MICH). In Southern Ontario, *P. atropurpurea* shows a highly disrupted pattern of distribution (see Fig. 3). In addition to the five stations known on Manitoulin Island, there are others along the mainland portion of the Niagara Escarpment, at both the Bruce Peninsula and Niagara Peninsula ends of this important series of exposures. One record which would have provided an intermediate location could not be plotted because of insufficient data: WELLINGTON Co.: [without exact locality][1] *J. E. Howitt* (OAC #2044).

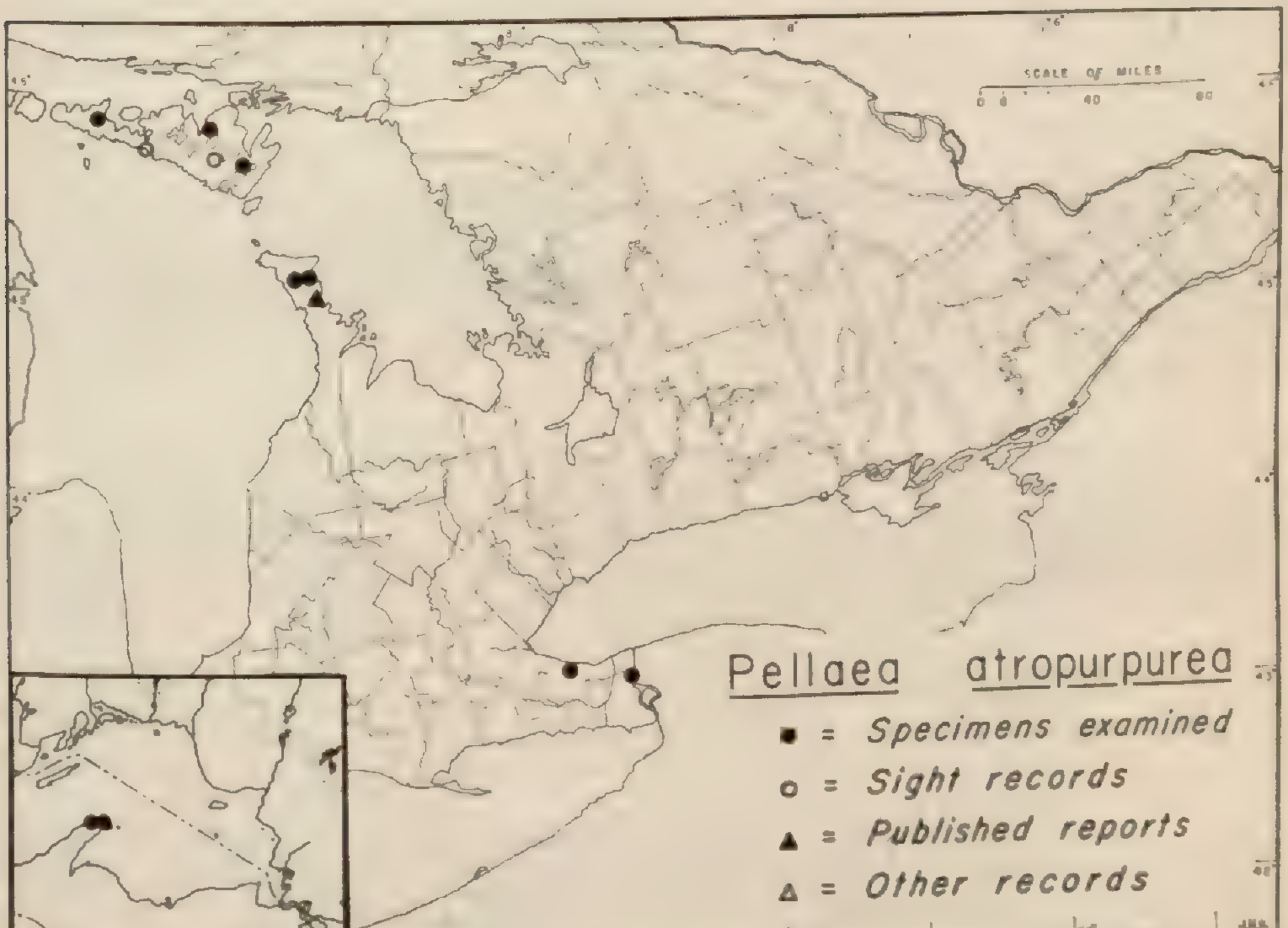


FIGURE 3. DISTRIBUTION OF PELLAEA ATROPURPUREA IN SOUTHERN ONTARIO. INSET GIVES RECORDS FOR ADJACENT PORTION OF NORTHERN MICHIGAN.

11. PELLAEA GLABELLA Mett. ex Kuhn—Crevices of limestone cliff face about 1 mile E of West Bay, 27 July 1952, *S & G 5709*; loc. cit., 26 July 1956, *S & F 6613*; on exposed limestone cliffs (facing NW) and in crevices at top of escarpment, East Bluff, 1 mile NE of Gore Bay, 24 July 1959, *S & H 8972*; in crevices of cliffs along escarpment, High Hill, S of Honora, 12 Sept. 1962, *S & H 9513*; on rocky edge of cliff face, headland between

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[1] Prof. F. H. Montgomery of the Ontario Agricultural College, Guelph, has informed me that the most likely collecting spot for J. E. Howitt in this case would have been the Elora area, which is northeast of Guelph on the Grand River.

Helen Bay and Campbell Bay, 13 Sept. 1962, *S & H 9542;* on face of cliff at summit of talus slope, S end of Ice Lake, 14 Sept. 1962, *S & H 9560.*

This species is rare on Manitoulin Island but it is common along the Niagara Escarpment on the mainland from the Bruce Peninsula to the Niagara River (see Fig. 4). It also occurs on the north shore of Lake Superior and in the Lake-of-the-Woods district. Additional records for the area south of the Great Lakes will be found on a map published by Alice F. Tryon (1957, p. 137, map 2B). The westernmost record near the upper left corner of the map is based on a recent collection from Drummond Island, Michigan: ledges of cliff face, Marblehead, 1 Sept. 1961, *J. K. Hiltunen 3675* (WUD). The two records for *P. glabella* in the eastern part of Southern Ontario may actually refer to a single locality. The discovery of this species by W. G. Dore and J. M. Gillett in 1955 on the face of a limestone cliff along Jones Creek about 7 miles SW of Brockville has validated a much earlier (but long unconfirmed) collection by N. H. Cowdry for which the locality was simply given as Brockville. Since the bedrock at Brockville is Precambrian, it is more likely that the Cowdry specimen was actually collected on the nearby limestones.

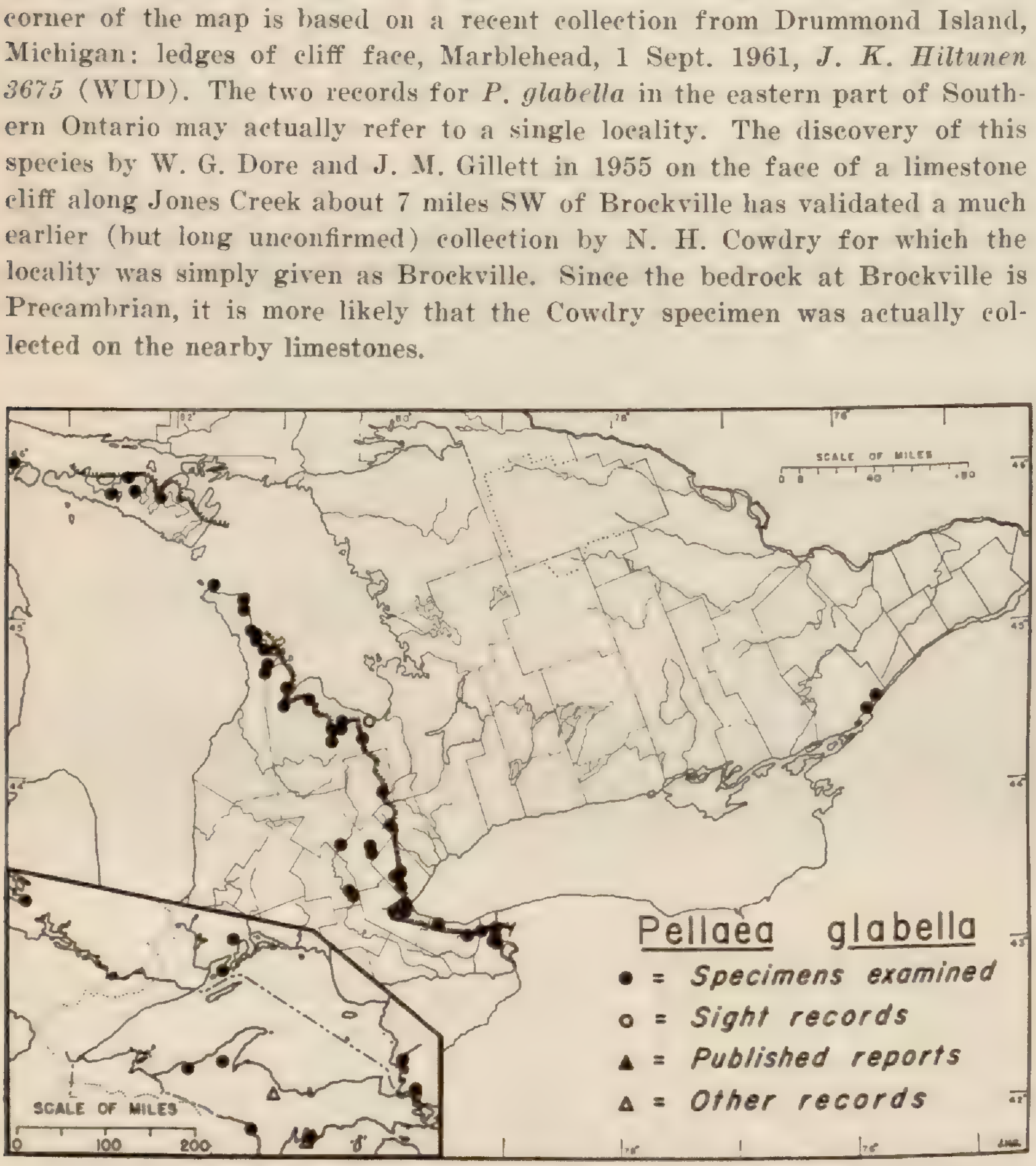


FIGURE 4. DISTRIBUTION OF PELLAEA GLABELLA IN SOUTHERN ONTARIO. INSET GIVES RECORDS FOR THE LAKE SUPERIOR REGION. THE HACHURES INDICATE THE POSITION OF THE NIAGARA ESCARPMENT.

ASPIDIACEAE

12. MATTEUCCIA PENSYLVANICA (Willd.) Raymond—In low wet woods on north shore of Marsh Lake, 9 July 1957, *S, G, & D 7298;* rocky stream bed in gorge 4 miles NE of Gore Bay, 28 July 1959, *S & H 9015;* in damp soil along stream flowing into Manitou River near its mouth, 14 Sept. 1961, *S & Co 9313.* Sight records: Bluejay Creek, Cape Robert, High Falls, Honora, Ice Lake, Mississagi Strait, Sounding Cove, Treasure Island in Lake Mindemoya; Cockburn Is.; Great Duck Is.

The Ostrich Fern is occasional throughout Manitoulin Island. Other collections: near Sounding Cove and Wikwemikong, *C. O. Grassl 1519 & 1642* (MICH): 4 miles NW of Lily Lake, *H. H. Brown 5576* (TRT).

13. ONOCLEA SENSIBILIS L.—In low wet woods below escarpment NW of Rockville on W side of Manitou Lake, 12 Sept. 1961, *S & Co 9309;* damp soil along stream flowing into Manitou River near its mouth, 14 Sept. 1961, *S & Co 9331.* Sight records: Bluejay Creek, Gore Bay, High Falls, Honora, Ice Lake, 8 miles SW of Manitowaning, Marsh Lake, Michael Bay, Mud Lake, Poole Lake, Roberts Bay to Thomas Bay, Silver Lake, Silverwater, South Baymouth, West Bay; Cockburn Is.; Great Duck Is.

Sensitive Fern is common throughout the area in suitable habitats. Other collections: Sounding Cove and Cockburn Is., *C. O. Grassl 1654 & 1655* (MICH); Wikwemikong and Great Duck Is., *W. Koelz 4278 & 4529* (MICH); 4 miles NW of Lily Lake, *H. H. Brown 5577* (TRT); Fall's Lake, *D. K. Brown 24* (TRT).

14. DRYOPTERIS CRISTATA (L.) Gray—In shady swamp near lakeshore SE of lighthouse, Missisagi Strait, 22 July 1959, *S & H 8948.* Sight record: SE tip of Great Duck Is.

The Crested Shield Fern is rare and local with only five stations represented by specimens. Other collections: between Frost Point and Bass Lake near Sheguiandah, Wekwemikongsing, and Providence Bay, *C. O. Grassl 1507, 1664 & 5858* (MICH); 4 miles NE of West Bay, *H. H. Brown 5568* (TRT).

15. DRYOPTERIS FILIX-MAS (L.) Schott—In seams of limestone along brow of escarpment on W side of Lake Manitou, 7 July 1953, *S & K 5867.* This appears to be the first collection of the Male Fern on Manitoulin Island. It is known elsewhere in Ontario only from two parts of the Niagara Escarpment in Bruce, Grey and Simcoe counties.

16. DRYOPTERIS MARGINALIS (L.) Gray—On rocky ledge in maple woods along SE shore of Perch Lake, 8 July 1957, *S, G, & D 7245;* crevices of limestone at base of escarpment NW of Rockville on W side of Manitou Lake, 12 Sept. 1961, *S & Co 9306.* Great Duck Is.: in woods with *Taxus* at NW corner of island, 11 July 1957, *S & G 7349;* woods just N of main E-W trail across island, 28 June 1959, *S & H 8694.* Sight records: East Bluff at

Gore Bay, Evansville, Green Bay, High Hill, Honora, Kaboni, 5 & 8 miles SW of Manitowaning, Mindemoya, Sheguiandah, Silver Lake, Sounding Cove, Tehkummah; Cockburn Is.; Birch Is.; 2 miles S of Whitefish Fall; Baie Fine; Killarney.

17. DRYOPTERIS SPINULOSA (O. F. Muell.) Watt var. SPINULOSA—In open swampy woods, Mud Lake, 5 July 1957, *S & G 7192*.

Other collection: 4 miles NE of West Bay, *H. H. Brown 5570* (TRT).

18. DRYOPTERIS SPINULOSA (O. F. Muell.) Watt var. INTERMEDIA (Muhl.) Underw. [*D. intermedia* (Muhl.) Gray]—On rotting log in mixed woods, East Bluff, 1 mile NE of Gore Bay, 24 July 1959, *S & H 8963*. Great Duck Is.: in moist shaded maple woods just N of main E-W trail across the island, 28 June 1959, *S & H 8689*. Inner Duck Is.: in *Taxus* thicket at edge of woods near shore, SE corner of island, 11 July 1957, *S & G 7323*.

Other collections: Sounding Cove, Providence Bay, and 5 miles S of Little Current, *C. O. Grassl 1524, 5871, & 5875* (MICH); Mindemoya, *L. Jenkins 7725* (DAO); Gore Bay, *M.C.T.* [*Thomson?*] (TRT #25261).

Unfortunately, no distinction was made in the field among the various taxa in the *D. spinulosa* complex. The following sight records, therefore, can be listed only under the heading of *D. spinulosa* (*sensu lato*): Bluejay Creek, Evansville, Frechette Bay, 4 miles NE of Gore Bay, High Hill S of Honora, Ice Lake, Little Current, W side of Lake Manitou, 8 miles SW of Manitowaning, Mindemoya, Mississagi Strait, Perch Lake, Poole Lake, Providence Bay, Roberts Bay to Thomas Bay, Silver Lake, Silverwater, Sounding Cove, South Baymouth, Wikwemikong; Cockburn Is.; Great Duck Is.; Outer Duck Is. Other collections: Heywood Is., Great Duck Is., Wekwemikongsing, 5 miles S of Little Current, and Providence Bay, *C. O. Grassl 1638, 1649, 5885, 6734, & 6735* (MICH); Rattlesnake Harbour and Wikwemikong, *W. Koelz 4229 & 4273* (MICH).

No specimens have been seen from the district which could be referred to ***D. spinulosa* var. *americana*** **(Fisch.) Fern.**

19. GYMNOCARPIUM DRYOPTERIS (L.) Newm. [*Dryopteris disjuncta* (Rupr.) Morton]—On mossy hummock in swampy woods, Mud Lake, 5 July 1957, *S & G 7190*; low wet woods below escarpment on W side of Manitou Lake, 12 Sept. 1961, *S & Co 9310*. Sight records: Bluejay Creek, Dean Bay, 5 & 8 miles SW of Manitowaning, Marsh Lake, Michael Bay, Mindemoya, Mississagi Strait, Poole Lake, Providence Bay, Roberts Bay to Thomas Bay, Silverwater, South Baymouth; Cockburn Is.; Great Duck and Outer Duck Islands.

The Oak Fern is common but not very abundant in the area. Other collections: Sounding Cove, Wikwemikong, and 5 miles S of Little Current, *C. O. Grassl 1520, 1645, & 5876* (MICH); 4 miles NE of West Bay, *H. H. Brown 5569* (TRT); Froude's Harbour, *K. K. Irizawa 49* (TRT).

20. GYMNOCARPIUM ROBERTIANUM (Hoffm.) Newm. [*Dryopteris robertiana* (Hoffm.) C. Chr.]—On limestone ledges at base of small cliff on rocky slope, Battery Bluff, near Cook's Dock, 17 July 1959, *S & H 8801*. This collection was believed to be the first record for Manitoulin until the following material (collected twenty-seven years earlier but unreported) was located: Battery Bluff, Providence Bay and Meldrum Point, *C. O. Grassl 1634, 5875, 5865* (MICH). Only one collection has been seen from the mainland of Southern Ontario, as follows: BRUCE Co.: Georgian Bay shore opposite Moore Lake, *P. V. Krotkov 9618* (TRT).

This species is very rare on Manitoulin Island. Its distribution in the Great Lakes region is shown on the map (Fig. 5), the records for Wisconsin and Minnesota having been obtained from the maps published by R. M. Tryon et al. (1953), R. M. Tryon (1954). The Manitoulin records provide a good connecting series between the single southernmost locality at the tip of the Bruce Peninsula and those on Drummond Island near the northwestern end of Lake Huron, where this species has been collected in two or three localities recently by Michigan botanists, R. McVaugh and J. K. Hiltunen. The map does not extend far enough east to include the recent discovery of this fern on Lake Timiskaming by W. K. W. Baldwin and E. Lepage (Baldwin, 1962, pp. 29 & 86).

I have not found *Gymnocarpium robertianum* and *G. dryopteris* growing together, for they occupy different types of habitats. The two species are distinct from each other in their habit of growth and in the glandularity, that of typical *G. robertianum* being different from that which occasionally occurs on plants of *G. dryopteris*. The glandular form of *G. dryopteris*[2] is sometimes confused with *G. robertianum* by those who are not familiar with the two species in the field. In Ontario the glandular form of *G. dryopteris* is occasional throughout the range of that species.

21. THELYPTERIS PHEGOPTERIS (L.) Slosson [*Dryopteris phegopteris* (L.) C. Chr.]—In damp woods along trail to Michael Bay, 28 July 1952, *S & C 5740*; loc. cit., 14 Sept. 1961, *S & Co 9316*. Great Duck Is.: moist shaded hardwood forest just N of the main E-W trail across the island, 28 June 1959, *S & H 8700*. Sight records: Marsh Lake, Mindemoya, Roberts Bay to Thomas Bay; Cockburn Is.

The Northern Beech Fern is occasional and local in the district and probably more common on the mainland. Other collection: Cockburn Is., *W. Koelz 4449* (MICH).

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[2] In order to refer to this form properly, it is necessary to propose the following new combination:
GYMNOCARPIUM DRYOPTERIS (L.) Newm., forma **glandulosa** (Tryon) Soper, comb. nov., based on *Dryopteris Linnaeana* C. Chr. forma *glandulosa* Tryon, Amer. Fern Journ. 29: 4. 1939.

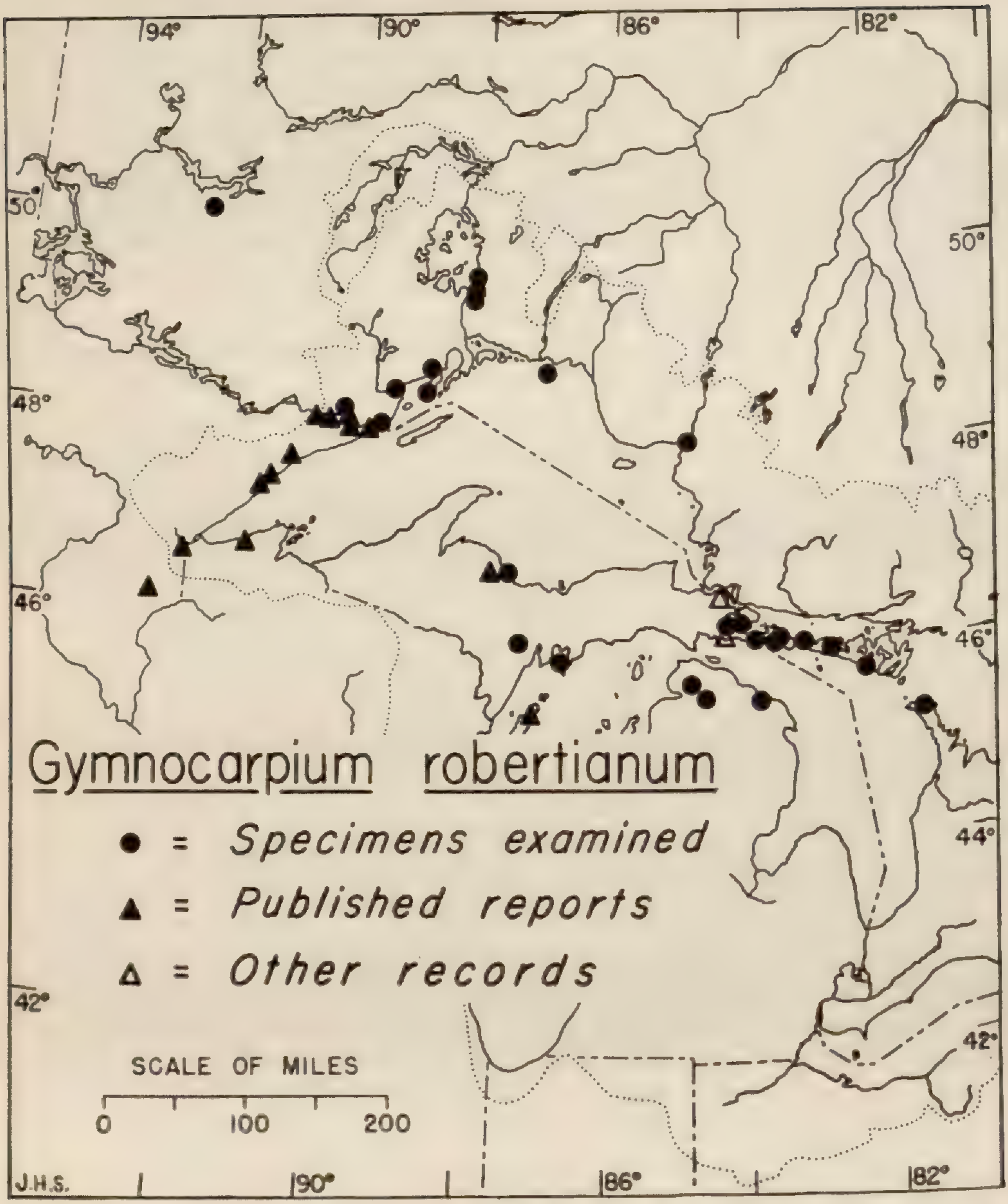


FIGURE 5. DISTRIBUTION OF GYMNOCARPIUM ROBERTIANUM IN THE UPPER GREAT LAKES REGION.

22. THELYPTERIS PALUSTRIS (Salisb.) Schott var. PUBESCENS (Lawson) Fernald [*Dryopteris thelypteris* (L.) Gray var. *pubescens* (Lawson) A. R. Prince ex Weatherby]—On tussock of grass in beaver pond south of Silver Lake, 29 July 1959, *S & H 9054*. Sight records: Frechette Bay, Honora, Mississagi Strait; Great Duck Is.

The Marsh Fern is occasional and local in the district. Other collections:

Great Duck Is., Helen Bay, Cockburn Is., and Leask Point, *C. O. Grassl 5862, 5866, 5867, & 5884* (MICH); 4 miles NW of Lily Lake, *H. H. Brown 5575* (TRT).

23. ATHYRIUM FILIX-FEMINA (L.) Roth var. MICHAUXII (Spreng.) Farw.—In damp clearing of woods around boggy lake, Mud Lake, 5 July 1957, *S & G 7193;* low damp woods near small lake N of Silverwater, 29 July 1959, *S & H 9047*. Sight records: Cape Robert, Dean Bay, Gore Bay, Manitou Lake, Marsh Lake, Michael Bay, Mindemoya, Poole Lake, South Baymouth, Tehkummah; Cockburn Is.; Great Duck Is.

Lady Fern is comparatively common and widespread throughout the district. Other collections: Sounding Cove, Indian village at South Bay, Little Current, and Wekwemikongsing, *C. O. Grassl 1641, 5854, 5874, & 5886* (MICH); Rattlesnake Harbour, Wikwemikong, West Bay and Cockburn Is., *W. Koelz 4223, 4283, 4349, & 4419* (MICH); 4 miles NE of West Bay, *H. H. Brown 5567* (TRT). Reported from Whiskey Is. [now William Is.] by Bell (1870).

24. CYSTOPTERIS BULBIFERA (L.) Bernh.—In damp soil along edge of stream below High Falls, 28 July 1952, *S & C 5736;* at base of waterfall on damp limestone ledges, Honora, 7 July 1957, *S & G 7227;* limestone ledges of escarpment 1 mile N of Green Bay, 15 July 1959, *S & H 8782;* under maples in rocky gorge 4 miles NE of Gore Bay, 28 July 1959, *S & H 9017*. Sight records: Dean Bay, Evansville, Gore Bay, Ice Lake, Kaboni, W of Manitou Lake, 5 miles SW of Manitowaning, Sounding Cove; Cockburn Is.; Great Duck Is.

The Bladder Fern is common and widespread within the area. Other collections: Sounding Cove, Cockburn Is., Indian village at South Bay, and Tamarack Point, *C. O. Grassl 1525, 1648, 5860, & 5870* (MICH); West Bay, *H. H. Brown 5540* (TRT); High Hill, Excelsior, *N. C. Fassett 14642* (MT); 10 miles S of Sheguiandah, *Senn & Lindsay 5343* (DAO); near Mindemoya, *Pease & Bean 26405* (GH).

25. CYSTOPTERIS FRAGILIS (L.) Bernh.—On mossy outcrops of limestone along shore of Manitou Lake about 1.5 miles E of Sandfield, 26 July 1952, *S & C 5671;* crevices of limestone along brow of escarpment W of Manitou Lake, 7 July 1953, *S & K 5869;* loc. cit., 12 Sept. 1961, *S & Co 9302;* along rocky ledges of escarpment in woods, Battery Bluff, Cook's Dock, 15 Sept. 1954, *S & D s.n.* (TRT #124678); on mossy boulders under edge of cliff, Mud Lake, 5 July 1957, *S & G 7167;* crevices of limestone in rocky woods 8 miles SW of Manitowaning, 7 June 1959, *S & H 8445;* rocky ridge in clearing near Poole Lake, 19 June 1959, *S & H 8543;* low limestone ridge in open woods near lighthouse at Mississagi Strait, 22 July 1959, *S & H 8945;* mossy crevices at base of limestone bluffs, East Bluff, 1 mile NE of Gore Bay, 24 July 1959, *S & H 8974;* damp limestone ridge in woods, Silver Lake, 23

July 1959, *S & H 8977*; on mossy boulders of wooded talus slope, High Hill south of Honora, 12 Sept. 1962, *S & H 9517*; on limestone rocks along edge of escarpment at south end of Ice Lake, 14 Sept. 1962, *S & H 9561A*. Sight records: "the Caves" (W side of Lake Mindemoya), Green Bay, High Hill near West Bay, 5 miles SW of Manitowaning, Perch Lake.

Fragile Fern is one of the common ferns of the district and is usually abundant wherever it is found. Other collections: Sounding Cove, Indian village at South Bay, Tamarack Point, Providence Bay, Rattlesnake Harbour, and Gore Bay, *C. O. Grassl 1521, 5861, 5868, 5883, 5888, & 6731* (MICH); West Bay, *H. H. Brown 5557* (TRT); Barrie Island, *D. K. Brown 55* (TRT); Manitowaning, *Pease & Ogden 24997* (GH, MICH, TRT); Big Lake, Murphy Point, West Bluff at Gore Bay, and 14 miles SW of Manitowaning, *Senn & Lindsay 5364, 5436, 5473, & 5492* (DAO); near Mindemoya, *Pease & Bean 26090* (GH).

26. WOODSIA ILVENSIS (L.) R. Br.—On quartzite ridge in open field near north end of Pike Lake, 3 miles W of Sheguiandah, 15 Sept. 1962, *S & H 9587*. This appears to be the only collection of this species on the island and its occurrence is undoubtedly related to the outcrops of Precambrian rock in the vicinity of Sheguiandah.

27. WOODSIA OREGANA D. C. Eaton var. CATHCARTIANA (Robins.) Morton—On rocks of escarpment overlooking West Bay, 26 July 1956, *S & F 6608*; mossy edge of boulder in rocky woods E of Windfall Lake, 4 July 1957, *S & G 7158*; crevices of limestone flats beside creek flowing out of Perch Lake, 8 July 1957, *S, G, & D 7247*; limestone ledges and crevices along brow of escarpment 1 mile N of Green Bay, 15 July 1959, *S & H 8780*; Battery Bluff, Cook's Dock, 17 July 1959, *S & H s.n.* (TRT # 124679); ledge of low limestone ridge in open woods NW of Silver Lake, 20 July 1959, *S & H 8896, 8902, 8905*; rocky talus slope below brow of escarpment, East Bluff, 1 mile NE of Gore Bay, 24 July 1959, *S & H 8975, 8976*; crevices of large boulders at base of escarpment NW of Rockville on W side of Manitou Lake, 12 Sept. 1961, *S & Co 9304*; on boulder below cliff summit on talus slope of headland between Helen Bay and Campbell Bay, 13 Sept. 1962, *S & H 9541*; on limestone rocks along edge of escarpment at S end of Ice Lake, 14 Sept. 1962, *S & H 9561B*. Sight records: "the Caves" (W side of Lake Mindemoya), Mindemoya, Poole Lake.

This fern is locally abundant on ledges, cliffs and talus slopes but it is not nearly as wide-ranging as *Cystopteris fragilis*. Other collections: Sounding Cove, *C. O. Grassl 1523* (MICH); Michael Bay, *H. H. Brown 5607* (TRT); High Hill, 1.5 miles NE of West Bay village, *Jenkins & Dalton 7731* (DAO); Murphy Point, *H. A. Senn 6040* (DAO); near Tehkummah, *Pease & Ogden 25025, 25037* (GH); High Hill, Excelsior, *N. C. Fassett 14951* (WIS), as *W. mexicana:* see discussion by Fassett (1933, p. 389).

LITERATURE CITED

BALDWIN, W. K. W. *et al.* 1962. Report on Botanical Excursion to the Boreal Forest Region in Northern Quebec and Ontario. 107 pp. Dep't. Northern Affairs & National Resources, Ottawa.

BELL, JOHN. 1870. On the Plants of the Manitoulin Islands. Appendix to Report of Progress from 1866-1869, Geol. Surv. Can., pp. 449-469.

FASSETT, N. C. 1933. Notes from the Herbarium of the University of Wisconsin—X. Rhodora **35:** 387–391.

TRYON, ALICE F. 1957. A Revision of the Fern Genus *Pellaea* section PELLAEA. Ann. Missouri Bot. Gard. **44:** 125–193.

TRYON, R. M., FASSETT, N. C., DUNLOP, D. W., & M. E. DIEMER. 1953. Ferns and Fern Allies of Wisconsin. ed. 2, Madison.

TRYON, R. M. 1954. Ferns and Fern Allies of Minnesota. Minneapolis.

(To be continued)

DEPARTMENT OF BOTANY, UNIVERSITY OF TORONTO, TORONTO, CANADA.

Observations on Cultivated Ferns. VII. The Mother Ferns

C. V. MORTON

There are two species of cultivated ferns that are commonly called "Mother Ferns," because of their ability to produce small plantlets on the fronds of the mature ferns. These small plants, looking like sporelings, are produced, sometimes copiously, from scaly buds, which arise sometimes from the rhachises but mostly from the midribs of the pinnules or even from the ultimate veinlets, always on the ventral side of the frond. It would seem obvious that this is a form of vegetative propagation, and doubtless it is, in nature. Presumably the plantlets fall off and take root. However, in cultivation it seems to be difficult or impossible to get these plantlets to grow once they are separated from the mother. Reports of experiences with plantlets would be welcome.

The two species mentioned above are commonly known as *Asplenium bulbiferum* Forst. fil. and *Asplenium viviparum* (L. fil.) Presl, both appropriate and descriptive names. Unfortunately, the latter is not a correct name under the International Code of Botanical Nomenclature. Although the oldest name for

the species is *Acrostichum viviparum* L. fil. (1781), the combination *Asplenium viviparum* (L. fil.) Presl dates from 1836, and is thus a later and illegitimate homonym of the different species *Asplenium viviparum* Blume (1828). The next oldest name is *Asplenium daucifolium* Lam. (1786), which is a correct name.

Both species are variable, as are many other Aspleniums. Some of the variations of *A. bulbiferum* are discussed by H. H. Allan,[1] who also mentions some hybrids of this species with other New Zealand species (*op. cit.* 75). The fronds vary from bipinnate to tripinnate or even tripinnate-pinnatifid. The variation of the other species *A. daucifolium* Lam., which is native in Réunion, Mauritius, and Madagascar, is even greater, the fronds varying from simply pinnate, with large broad pinnae, to quadripinnate, with delicate filiform segments. A number of these variants have been assigned species status, and they certainly do appear to be different off-hand. Still, those botanists who have studied them closest find that they differ in no way other than dissection, and the extremes are connected by intermediates. Mettenius[2] was perhaps the first to note this variability. Later, Cordemoy[3] studied these plants more carefully, and described five types, with some subtypes, but unfortunately he did not assign formal names to them, merely indicating his groups as, for instance, "C. Fronde bipinnatipartite," or "E. Fronde quadripinnatifide." Recently, Madame Tardieu-Blot[4] provided a usable treatment, with names for four varieties, but unfortunately she adopted for the species the incorrect name *A. viviparum*.

It would be interesting to investigate the cytological situation, but in order to do so it would undoubtedly be necessary to visit Réunion and Mauritius, both of which are somewhat off the beaten track nowadays, although they were both frequent ports-of-call in the days of sailing vessels. Very likely the simply pin-

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[1] Flora of New Zealand **1**: 71, 72. 1961.

[2] Abh. Senck. Naturf. Ges. **3**: 140, 141. 1858.

[3] Fl. Réunion 63-65. 1895.

[4] "Asplenium Malgaches," Mém. Inst. Sci. Madagascar, Ser. B, **7**: 47, 48, t. *1*, *2*. 1956.

nate form, originally described as *Asplenium lineatum* Swartz (1801) and *A. nodulosum* Kaulf. (1827) is biologically "typical." The type of *A. daucifolium* Lam. is one of the intermediate forms, but this is no objection to the use of the name. It often happens that the nomenclatural type is not the commonest form of a species or the most biologically typical. The generally accepted name *A. viviparum* was not originally applied to the biologically typical form either, for it was based on the end-product, the most dissected form.

Although surely specifically distinct, the two species *A. bulbiferum* and *A. daucifolium* are similar and doubtless remotely allied. Very likely they have been geographically isolated for a long time, the former in New Zealand and the latter in the Mascarene Islands and Madagascar. Although different in aspect, it is hard to point out definite key characters. The following will help in distinguishing them:

Scales of the rhachis beneath of an ovate type, many cells broad at the base; rhizome scales large, broad, with large cells; blades bipinnate to tripinnate-pinnatifid, ultimate segments rather coarse, not filiform.
A. BULBIFERUM

Scales of the rhachis beneath small, narrow, only a few cells wide, or subfiliform; rhizome scales smaller and narrower, with smaller cells; blades simply pinnate to quadripinnate, the tripinnate and quadripinnate forms with filiform ultimate segments ..... A. DAUCIFOLIUM

ASPLENIUM BULBIFERUM Forst. fil. Fl. Ins. Austr. Prodr. 80. 1786.

var. BULBIFERUM. Frond bipinnate.

var. TRIPINNATUM Hook. fil. Fl. New Zeal. **2:** 34. 1855. Frond tripinnate.

ASPLENIUM DAUCIFOLIUM Lam. Encyl. Méth. **2:** 310. 1786.

var. **lineatum** (Swartz) Morton, *comb. nov.* Frond simply pinnate.

Asplenium lineatum Swartz, Journ. Bot. Schrad. **1800**[2]**:** 51. 1801. Type: Mauritius, *Groendal* (Morton photograph 5820).

Asplenium nodulosum Kaulf. in Spreng. Syst. Veg. **4:** 83. 1827. Lectotypus: Mauritius, *Sieber* Syn. Fil. 69 (ST, Morton photograph 5821). No collection was cited originally, but most or all of the species described for Kaulfuss by Sprengel were based on specimens distributed by Sieber as his "Synopsis Filicum" or "Flora Mixta." Sieber's Flora Mixta no. 301 (HBG, Morton photograph 5488) also represents *A. nodulosum*, but it is not absolutely identical; it doubtless represents a second collection and is a syntypus.

Asplenium mascarenhense Fée, Gen. Fil. 194. 1852. Typus: Bourbon [Réunion], *de Montbrison*. A synonym fide Mme. Tardieu-Blot.

Asplenium balfourii Baker, Ann. Bot. **5:** 303. 1891. Typus; Bourbon, *Balfour.*

var. DAUCIFOLIUM. Frond pinnate-pinnatifid to bipinnate. Type: Ile de France [Mauritius], *Commerson* (Herb. Thouin, P; not seen).

Darea palmata Kaulf. Enum. Fil. 181. 1824. Typus: Mauritius, collector not indicated, perhaps *Sieber.*

Darea bifida Bory, Bélang. Voy. Bot. **2:** 54. 1833.

Asplenium lineatum var. *bipinnatisectum* Mett. Abh. Senck. Naturf. Ges. **3:** 140. Sept., 1858. Lectotypus: Mauritius, *Sieber*, Syn. Fil. 56.

Asplenium inaequale var. *bifido-furcatum* Moore, Ind. Fil. 137. 1859. Based on ***Darea bifida*** Bory.

Asplenium rutaefolium var. *palmatum* Moore, Ind. Fil. 163. 1860. Based on ***Darea palmata*** Kaulf.

Asplenium lineatum var. *bipinnatum* Hook. Sp. Fil. **3:** 104. 1860 (prior to May). Lectotypus: Mauritius, *Sieber*, Syn. Fil. no. 56 (cited by Hooker), presumably at K. Isolectotypus: *Sieber*, Syn. Fil. 56 (HBG, Morton photograph 5490).

Asplenium subdigitatum Mett. ex Kuhn, Fil. Afr. 117. 1868. Based on *Darea palmata* Kaulf. (non *Asplenium palmatum* Lam.).

Asplenium viviparum var. *daucifolium* Tard. Mém. Inst. Sci. Madagascar, Ser. B, **7:** 47. 1956.

var. **inaequale** (Willd.) Morton, *comb. nov.* Frond tripinnate.

Darea inaequalis Willd. Sp. Pl. **5:** 298. 1810. Typus: Bourbon [Réunion], *Bory.* (Presumably B, not seen).

Caenopteris inaequalis Bory ex Willd. *loc. cit. in syn.*

Asplenium viviparum var. *inaequale* Tard. Mém. Inst. Sci. Madagascar, Ser. B, **7:** 48. 1956.

For additional synonymy, see Tardieu-Blot, *op. cit.*

var. **viviparum** (L. fil.) Morton, *comb. nov.* Frond quadripinnate.

Acrostichum viviparum L. fil. Suppl. 444. 1781. Typus: Ile de France [Mauritius] and Bourbon [Réunion], *Sonnerat.*

Asplenium viviparum Presl, Tent. Pterid. 109. 1836, non Blume, 1828.

SMITHSONIAN INSTITUTION, WASHINGTON 25, D. C.

Shorter Notes

COMMON VS. TECHNICAL NAMES.—Many amateurs favor the use of "common" or colloquial names for ferns, holding that technical ones are too difficult to remember; and what difference does it make, anyway? Sometimes it can.

In a recent Handbook of the Brooklyn Botanic Garden on gardening with native plants, Miss Caroline Dormon, an outstanding southern wild flower gardener, noted that she was successfully growing "*Polystichum lonchitis.*" (p. 61). As that is a northern and subarctic limestone ledge plant, that it could survive in rich soil in the mild climate of Louisiana seemed doubtful, so I wrote my friend about it.

It turned out that the plant referred to was known thereabouts as Holly Fern, and "the books" gave the technical name of that as *Polystichum lonchitis.* However, on looking into the matter further, Miss Dormon found that what she had was actually *Cyrtomium falcatum,* a warm-climate species.

If uninformed lowland fern gardeners proceed to purchase the northern plant from dealers, they are going to be disappointed at its failure to thrive. Only if they are willing to learn the technical names and native haunts of the several so-called "Holly Ferns" will they be able to order plants suitable for their environment intelligently.—EDGAR T. WHERRY, *University of Pennsylvania.*

BOTRYCHIUM ALABAMENSE MAXON IN VIRGINIA.—While on the staff of the University of Virginia Mountain Lake Biological Station in August 1962, Dr. Warren H. Wagner, Jr., of the University of Michigan, visited our herbarium. Among the Pteridophytes he discovered a specimen of *Botrychium alabamense* Maxon, which we had not recognized as such. The species had not been reported in the range covered by the manuals. Since we had not made a critical study of the genus, the specimen was labeled a variant of *B. dissectum* var. *obliquum* (Muhl.) Clute. The specimen was collected September 28, 1942, by A. B. Culbertson (a former student) in the "Hurricane" area 4 miles north-

east of the town of Wise, the county seat of Wise County, Virginia.

Botrychium alabamense was described first by Maxon (Proc. Biol. Soc. Wash. **19**: 23, 1906). Clausen (Mem. Torrey Club **19**(2) : 46. 1938) treated it in his monograph. Blomquist (Ferns of North Carolina. Duke University Press. p. 24, 27-28. 1934) illustrated the species and gave briefly the characteristics in a key. Maxon's original description was based on specimens from Spring Hill, Alabama, about seven miles west of Mobile. It has been recorded since as far north as North Carolina. We can now report it in Wise County, Virginia, a northward extension of approximately 150 miles into the range of Gray's Manual, 8th Edition.

The species is recognized by the obovate, obtuse shape of the ultimate leaf segments, which may be broader than long; the margin is finely toothed. The habitat is open thickets and woodland and it is most obvious in the fall of the year.—A. B. MASSEY, *Virginia Polytechnic Institute, Blackburg, Va.*

OPHIOGLOSSUM PALMATUM IN COSTA RICA.—Most of the adder's-tongues, *Ophioglossum*, are small terrestrial plants of open, grassy places, but there are two unique species in the tropics that are epiphytic, the Old World *O. pendulum* and the American *O. palmatum*, also known as *Cheiroglossa palmata*, the "Hand Fern." It is rarely found, at least in Costa Rica, where it is confined to the low and intermediate parts of the rain-forests.

The first specimen I found, in January, 1957, was on the mountain called Fila de Chirripó, in a dense rain-forest at about 800 meters elevation. This area is particularly wild, and covered with a virgin, partly impenetrable forest. In the spring of 1960, I found it in the region of La Palma, north of San José. The region of La Palma is one of the most fertile botanical collecting grounds in Costa Rica. It is a wide, shallow saddle within the Cordillera Central, bordered on the west by Cerro Zurquí (2,400 meters), and on the east by towering Volcán Irazú (3,479 meters). The heavy, rain-bearing clouds from the Atlantic rush through the saddle and leave most of their moisture in the La Palma re-

gion. The tree-trunks, laden with mosses, liverworts, and orchids, are the habitat of *Ophioglossum palmatum*. Old trees along river banks seem to be the preferred habitat. It grows solitary in heavy cushions of moss on the tree trunks, projecting up to a half dozen pendulous, lobed fronds, each provided with a number of upright fertile spikes. The fronds are fleshy and flexible, and similar in general aspect to those of a small *Platycerium*.

Ophioglossum palmatum is probably impossible to grow from spores, because of a symbiotic association between its root and a fungus, so live specimens can be obtained only by importation of living plants. It apparently needs years to develop into mature plants, and it is never found on very young trees. It is probably rather easily cultivated if planted in a porous mixture of bark, leafmold, black forest soil, and sharp sand and kept under humid conditions.—CLARENCE HORICH, *San José, Costa Rica.*

Notes and News

JAPANESE EXCHANGE.—Dr. Kazuhike Mori, Mori Clinic, no. 49, 3 cho-me, Takami-cho, Tikusa-ku, Nagoya, Japan, writes that he has become interested in ferns. He has a greenhouse with more than 120 living species of Japanese ferns. He has expressed interest in corresponding with American fern gardeners and in exchanging specimens.—C. V. M.

THREAT TO CUT-LEAF FERN INDUSTRY.—For at least 20 years, the Pacific coast Western Sword Fern, *Polystichum munitum*, has provided an important part of the cut ferns used in the florists' trade. According to an article by Sandeno and Jensen[1] the trade in this fern amounts to about $5,000,000 per year.

These authors reported that some of the leaves shipped show discoloration in bands and wedge-shaped spots. The infecting agent has been identified as the nematode, *Aphelenchoides fragariae*.

The infections, found on both fronds obtained from a dealer and those collected in the field, appear first as water-soaked areas and become apparent in mature leaves under conditions of exces-

[1] Plant Disease Reports **40**: 699–701. 1962.

sive dampness during winter. The infected areas later become brown and remain conspicuous in older leaves when the new fronds uncoil in early summer. No infection was observed during the drier season of summer growth.

The article carries no estimate of the extent of nematode infection. The bibliography of 16 titles contains a reference to another fern species infected by nematodes, the Bird's Nest Fern, *Asplenium nidus*, often cultivated as a potted plant. A recollection of visits to successful growers of this species is that overhead watering is avoided. In botanic gardens where drip from hanging plants is frequent, *Asplenium nidus* often shows brown nematode infections.—RALPH C. BENEDICT.

Recent Fern Literature

REVISION OF SOME FILMY FERNS.—A fine addition to the small number of recent monographic treatments of ferns is "The New World Species of *Trichomanes* Sect. *Didymoglossum* and *Microgonium*" by J. G. Wessels Boer.[1] The sections treated contain the filmy ferns with filiform, epiphytic rhizomes, and scattered minute, often subcircular fronds, from a few millimeters to a few centimeters in length. The species of *Microgonium* (*T. godmanii* Hook., *T. ekmanii* W. Boer, *T. hookeri* Presl, and *T. kapplerianum* Sturm) are distinguished by having the fronds with glabrous margins and an intramarginal spurious veinlet. The American species of *Didymoglossum*, 15 in number, have simple or stellate hairs on the margins and no intramarginal veinlet. Mr. Wessels Boer does not come to any conclusions regarding the relationships between these two groups or their relationship to other sections of the genus.

The first part of the paper gives a brief account, with drawings, of the anatomy of the fronds. One of the characteristic features (although not restricted to the sect. *Didymoglossum*) is the presence of "false veinlets" between the true veins. These may be connected with the veins or may be distinct from them. They

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[1] Acta Bot. Neerlandica **11**: 277–330. *Fig. 1–34.* 1962.

very likely serve to strengthen the fronds, since they are composed of sclereids and certain peculiar supporting cells known as stegmata; they differ from the true veins in lacking tracheids. The number and orientation of these false veins is generally a good specific character.

All the United States species of *Trichomanes* belong to the section *Didymoglossum*, except *T. boschianum*, which is easily distinguished by its much larger size, pinnate division, and other characters. The United States species are keyed out by Wessels Boer as follows:

Involucres without dark-edged lips; fronds small (ca. 10 mm. long and 4 mm. wide), entire or only sublobate. Stipe as long as the frond; involucres wholly immersed ——— *T. petersii* A. Gray

Involucres with dark-edged lips; fronds mostly more than 10 mm. long, entire or lobed.

Fronds with pinnate venation, 2.5–9 cm. long; midrib evident nearly throughout ——— *T. krausii* H. & G.

Fronds essentially flabellate, 1–3 cm. long; midrib not extending beyond the middle.

Veinlets very thick, enlarged towards the margin, crowded, prominent in drying. Marginal hairs short and thick, deciduous with age. *T. lineolatum* v. d. Bosch

Veinlets thin, not enlarged towards the margin, more distant and not prominent in drying.

Interspaces much broader than the veinlets; well-developed fronds pinnately lobed — *T. punctatum* Poir. subsp. *floridanum* W. Boer

Interspaces between two veinlets narrow, about twice as broad as the veins; fronds roundish, in the upper part crenate or with only a few lobes — *T. punctatum* subsp. *sphenoides* (Kunze) W. Boer

The well-known *T. petersii* is rather common and widespread in the southern United States, coming north as far as North Carolina and Tennessee. It is now reported from Chiapas, Mexico, and from Guatemala, a notable instance of disjunct distribution. The other species are all rare and confined in the United States to southern Florida. The localities in the National Herbarium for *T. krausii* (often misspelled "*kraussii*") are: Nixon-Lewis Hammock, Timms Hammock, Sykes Hammock, and hammocks south of Cutler, all in Dade County. Also known only

from Dade County is *T. lineolatum* (Ross Hammock, and hammocks south of Cutler). The specimens formerly referred to *T. punctatum* Poiret are described as a new subspecies, subsp. *floridanum* Wessels Boer, a Florida endemic. The type is *Eaton* 561 from Large Hammock, east of Browns, Dade County. Other collections are from Royal Palm Hammock, Ross Hammock, Hattie Bauer Hammock, Sykes Hammock, Snapper Creek (south of Coconut Grove), and hammocks south of Cutler, all from Dade County. Wessels Boer has overlooked the Florida record for *T. sphenoides* Kunze, which he reduces to a subspecies of *T. punctatum*. Very likely this plant is still known in Florida only from the original collection by Robert P. St. John, from seven miles east of Floral City, Sumter County, February 7, 1936, which is presumably in the herbarium of the New York Botanical Garden. This locality is a long way from the Everglades where subsp. *floridanum* grows and the climate is different, as noted by Small (Ferns of the Southeastern States, p. 50), and it is therefore not unlikely that the identification as *sphenoides* is correct; however, the determination should be reviewed in the light of the new treatment of Wessels Boer.—C. V. MORTON.

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1963 FERN FORAY.—Time: August 23-25. *Place:* Wallingford-Dorset-Woodstock area in Vermont. *Headquarters:* Wallingford Inn, Wallingford, Vt. *Committee in charge:* Dr. Benjamin R. Allison and Dr. Ralph C. Benedict. *Local guide:* Henry Potter.

All participants *must:* 1) make advance reservations *direct* with Wallingford Inn or motel in vicinity not later than July 10th; 2) write to Dr. Richard L. Hauke, Department of Botany, University of Rhode Island, Kingston, R. I., telling him number in party and whether arriving by private car or public transportation. **(Not later than August 1.)**

Arrive at Wallingford evening of 22nd because field trip starts early 23rd. Leave for Amherst early 26th.

Suggestions to Contributors to the American Fern Journal

1. Authors of papers submitted to the *American Fern Journal* should consult the *Style Manual for Biological Journals* (1960) and be guided by its examples.

2. The "name-and-year" system for bibliographic references will, except in exceptional cases, be used. (See Literature Cited below for an example).

3. Authors are encouraged to use the journal abbreviations set forth by Schwarten and Rickett (1958, 1961).

4. Abbreviations of names of herbaria will be those listed by Lanjouw and Stafleu (1959).

5. Reports of chromosome numbers will not be accepted unless documented.

6. The use of footnotes and tabular matter should be kept to a minimum.

7. All manuscripts submitted for publication should be typed, double-spaced, and have ample margins.

8. Reprints should be ordered when galley proof is returned to the Editor. An order blank will be included with the galley proof.

Literature Cited

American Institute of Biological Sciences, Committee on Form and Style of the Conference of Biological Editors. 1960. Style Manual for Biological Journals. American Institute of Biological Sciences. Washington, D. C. 100 p.

Lanjouw, J., and F. A. Stafleu. 1959. The Herbaria of the World. Index Herbariorum, Regnum Veg. **15**: 1-249.

Schwarten, L., and H. W. Ricket. 1958. Abbreviations of Titles of Serials Cited by Botanists. Bull. Torrey Club **85**: 277-300; 1961. Supplement I. Ibid. **88**: 1-10.

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VOL. 53 JULY-SEPTEMBER, 1963 NO. 3

American Fern Journal

A QUARTERLY DEVOTED TO FERNS

Published by the

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C. V. MORTON ROLLA M. TRYON
JOHN H. THOMAS

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American Fern Journal

VOL. 53 JULY-SEPTEMBER, 1963 No. 3

Observations on the Sensitive Fern

RALPH C. BENEDICT

Through the years of this century, during which ferns of many kinds have been the objects of special studies from several points of view,—taxonomic, cytogenetic, physiological, morphogenetic, etc.,—the common weedlike Sensitive Fern seems to have been ignored except for its inclusion in lists of species from certain areas, or in general books on ferns. Within recent years, however, my attention has been drawn to certain features of its growth and life history that deserve study. The following paragraphs present a report on two of these features.

SPORE DISTRIBUTION.—Among our native northeastern ferns, the Sensitive Fern shares with the Ostrich Fern and the Narrow Chain Fern the distinction of producing fertile leaves that are sufficiently woody to persist as erect structures through the snow and ice of the winter season. At least in the Sensitive Fern the beadlike pinnules remain tightly closed until the spring season. Then they open and discharge spores at what probably is the most propitious season for spore germination. I am unable to say whether the other two species also carry undischarged spores through the winter.

The stipes of fertile leaves on the Sensitive Fern and Ostrich Fern develop a very thick and woody condition during their growing season. In the Sensitive Fern the sporophylls always seem to be curved near or at their insertion on the rootstock. The base of the stipe often describes a curve of 180 degrees before attaining an erect growth.

In mid-May of 1961 I had an excellent chance to observe the

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time of expansion of the pinnules and the beginning of distribution of spores among plants of *Onoclea sensibilis* in the Lake George area. Professor Bernard O. Phinney of the Department of Botany at the University of California in Los Angeles, wrote that he had urgent need of three milliliters of *Onoclea* spores for experimental purposes. The same day I crossed the road at my Pilot Knob home and began to search a marshy area where this fern abounds. The new vegetative leaves were almost fully developed—as much as two feet or more in height—in colonies that covered many square yards. Sporophylls remaining from 1960 were hard to see among the crowded, pale green vegetative fronds, but I had the assistance of a nine-year-old friend whose shorter stature afforded an advantageous lateral perspective. Within a short time we had collected 300 of the spikelike, rigid sporophylls. A package of the fertile blades was shipped immediately via air mail. Professor Phinney later wrote that he had obtained over 100 milliliters of spores from the 300 sporophylls!

On the first day of collection, no dehiscence or spore discharge was noted among any of the 300 sporophylls. A week later, when I collected 140 more of the 1960 sporophylls, at least 80 percent showed some early dehiscence among the apical pinnules and some even discharged little puffs of brown spores when picked. Undoubtedly the date of spore release will vary from season to season and in different latitudes. Two further questions may be raised: Is there any area where *Onoclea* spores regularly are distributed in the fall? Is there ever sufficient irregularity in the fall weather which might lead to an unusual, pre-winter discharge of spores?

FORMA OBTUSILOBATA.—This fern was named first in 1809 (Schkuhr, 1809) as a species, reduced to varietal rank by John Torrey (1843), and dropped to *forma* by Gilbert (1901). Underwood (1881) explained the *obtusilobata* variety as due to injuries to the vegetative leaves while the fertile sporophylls were still undeveloped. Such injury might often occur during haying operations in wet meadows where the Sensitive Fern often abounds

or through browsing by cattle in moist pastures. Weatherby (1936) described forma *obtusilobata* as "Fronds intermediate between normal fertile and normal sterile conditions, bipinnate or nearly so, the pinnules flat and nearly free-veined, sometimes partially fertile—exactly what one might expect if the normal fertile pinnules were spread out flat."



Figure 1. Onoclea sensibilis var. obtusilobata.

Neither the Underwood or Weatherby explanation is adequate to cover the whole range of diversity of form or circumstances of development which have been reported. The leaves shown in the accompanying illustration are certainly not bipinnate. The most contracted one would readily pass for fertile leaves of the Narrow Chain Fern and are hereafter referred to as the "lorin-

serioid" type. The specimens pictured were found during the 1954 field meeting of the American Fern Society, which had its first headquarters at Pilot Knob, New York. The locale was on the eastern edge of a swamp several hundred acres in extent, which is the source of three streams that flow into the main southeastern bays of Lake George. New York State Route 9L passes a part of this swamp near what used to be known as Brayton's Corners, about ten miles north of Glen Falls, New York. The field party had stopped for a brief inspection of the edge of the swamp for possible hybrids in *Dryopteris*. The leaves of *Onoclea* were taken from several separate plants growing on a low bank just above the wet swamp floor. They had the usual complement of vegetative leaves and there was none of the congested, beaded, typical fertile sporophylls present. I am indebted to Mr. F. Gordon Foster for the photograph from which the illustration was made.

A visit to Washington during the fall of 1962 allowed me to inspect the *obtusilobata* material in the National Herbarium. It consisted of 24 sheets with at least three times that number of separate specimens. Most of these corresponded to the form ordinarily considered *obtusilobata*, but the remainder showed a wide diversity. One or two were lorinserioid like the specimens shown in the illustration. One was slender and tall, but with beadlike pinnules on widely separated pinnae. Some showed partly pinnatifid leaf lobes but the remainder of the sporophyll modified toward the fertile form. Perhaps the most strikingly different leaf consisted of three-quarters normal, well-developed foliage lobes, and the rest of "typical" fertile pinnae.

In spite of the fact that the Sensitive Fern has been reported as fossils from the Eocene (Benedict, 1931) the genetic status of the present population seems to be remarkably stable. Its capacity for teratological variation seems remarkably high and its abundance and ease of cultivation suggests that it would be an ideal subject for experimentation.

Underwood's explanation of the *obtusilobata* form as a re-

sponse to injury has been accepted generally. However, a month after Underwood's paper appeared, George Davenport[1] published an article in the same periodical (Davenport, 1881) in which he questioned the completeness of Underwood's explanation. Although Davenport agreed that early injury to vegetative leaves of the Sensitive Fern often would result in the later appearance of the *obtusilobata* form, he cited what he believed to be exceptions to the completeness of the explanation. As a result of his field work and experimentation in the 1880's and 1890's he mentioned two exceptions: (1) The *obtusilobata* form may occur on plants that have not been injured; (2) The *forma* does not always occur on plants that *have* been injured. The circumstances under which the lorinserioid specimens shown in the illustration were found would support the first of these exceptions. The plants from which these fronds were collected bore normal vegetative leaves.

Final solution of the various phases of the problem involving the origin of leaf forms intermediate between normal vegetative and normal fertile leaves will require careful field work and experimentation. The abundance of this species and its occurrence in situations of reasonable uniformity provide ample opportunities for testing a series of questions about the cause of the variations. A few are suggested.

1. How long a period elapses between unrolling of the vegetative leaves and initiation of uncoiling of sporophylls?

2. What is the critical period during which destruction of vegetative leaves will induce primordia of sporophylls to change their course of development?

3. Are there any extrinsic factors that may operate to transform potential sporophylls into intermediate forms? A hard freeze in May certainly will destroy young leaves of the Sensitive

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[1] George E. Davenport, a furniture dealer in Boston, was one of several able fern students among the members of the American Fern Society when it was formed in 1893. He has to his credit several worthwhile papers, including the description of the first American *Dryopteris* hybrid (Davenport, 1894) then called *Aspidium cristatum* × *marginale.* [R.C.B.]

Fern and of its frequent companion, the Ostrich Fern.

4. Could another extrinsic factor be high intensity of light? If some accident of wind, or the fall of a branch from a nearby tree should bend the vegetative leaves and pin them horizontally to the ground—without seriously injuring their tissues—while the fronds were in an early stage of development, the sporophyll primordia would be subjected to higher than normal light intensity. Might this cause such primordia to change toward the organization of foliage leaves and result in intermediate forms of leaves on a plant possessing its complement of ordinary vegetative leaves? If so, this might explain one of Davenport's "exceptions."

A final point: in one instance I found the Sensitive Fern easy to cultivate indoors during the winter. In 1950 I transferred a rhizome from a backyard garden into a window bench in the botany department at Brooklyn College. What had been a stunted, although fertile, garden specimen became a thrifty growth of normal vegetative fronds, and in time produced two normal fertile sporophylls. Light coming through a north window was supplemented, 24 hours a day, by the illumination from a 1,000 watt incandescent light.

LITERATURE CITED

[BENEDICT, R. C.] 1931. The Oldest Living Fern. Amer. Fern Jour. **21**: 111.

DAVENPORT, G. E. 1881. *Onoclea sensibilis*, var. *obtusilobata*. Bull. Torrey Club **8**: 109–111.

———. 1894. Two new Ferns from New England. With some observations on hybridity and nomenclature. Bot. Gaz. **19**: 492-497.

SCHKUHR, C. 1809. Vier und zwanzigste Klasse des Linneschen Pflanzensystems oder Kryptogamische Gewächse. pp. 212, 219 pls. Wittenberg.

TORREY, JOHN. 1843. A Flora of the State of New York. 2 vols. New York.

UNDERWOOD, L. M. 1881. *Onoclea sensibilis* L., var., *obtusilobata* Torr. Bull. Torrey Club **8**: 101, 102.

WEATHERBY, C. A. 1936, 1937. A List of Varieties and forms of the Ferns of Eastern North America. Amer. Fern Jour. **26**: 11–16; 130–136; **27**: 20–24; 51–56.

PILOT KNOB, NEW YORK.

New Chromosome Numbers in Polypodium L.

ROBERT M. LLOYD

The cytotaxonomy of the circumpolar complex centering around *Polypodium vulgare* L. has been well worked out in Europe (Shivas, 1960a,b). In contrast, few counts have been available for members of the complex from North America.

On the western seaboard of the United States four distinct species of *Polypodium* occur. Manton (1951) reported diploid (n=37) counts for three of them, *P. glycyrrhiza, P. hesperium,* and *P. scouleri,* and a tetraploid count (n=74) for the fourth, *P. californicum.* Knobloch (1962) recently reported a tetraploid count for *P. hesperium.* New counts of *P. californicum* and *P. hesperium* from areas removed from the localities where earlier counts were made are presented here.

METHODS AND MATERIALS

Methods of slide preparation were identical with Manton's (1950) except that aceto-orcein was used instead of aceto-carmine. Both boiling and squashing were used on each slide to good advantage. Living rhizomes were collected in the field and cultivated in the greenhouse until suitable fertile fronds appeared. Material was fixed in a 6:3:1 solution of absolute ethanol:chloroform:glacial acetic acid. All stages of division were found in material fixed in the afternoon.

RESULTS

Meiotic material of *P. californicum* from four localities in southern and central California had formed 37 bivalents at meiotic metaphase I in spore mother cells. Tetraploid plants have been found only in the central and northern parts of the State.

Polypodium hesperium formed about 74 bivalents in a plant from Arizona, which was therefore tetraploid.

Voucher specimens are deposited in the herbarium of the Rancho Santa Ana Botanic Garden, Claremont, California.

Table I summarizes chromosome counts for these two species.

TABLE 1.

CHROMOSOME NUMBERS OF P. CALIFORNICUM AND P. HESPERIUM

Species	*n* Number	Location	Source
P. californicum	74	Portola, San Mateo Co., Calif.	Manton, 1951
	74	Searsville Lake, San Mateo Co., Calif.	Manton, 1951
	74	Russian Gulch State Park, Mendocino Co., Calif.	*Lloyd 502*
	37	Big Sur State Park, Monterey Co., Calif.	*Lloyd 537*
	37	Limekiln Canyon, Monterey Co., Calif.	*Lloyd 529*
	37	Kirk Creek, Monterey Co., Calif.	*Lloyd 520*
	37	Evey Canyon, Los Angeles Co., Calif.	*Lloyd 573*
P. hesperium	37	Columbia River, Oregon.	Manton, 1951
	74	Santa Catalina Mts., Arizona	Knobloch, 1962
	c. 74	Oak Creek Canyon, Coconino Co., Ariz.	*Lloyd 546*

The importance of further cytotaxonomical study in the *P. vulgare* complex was emphasized by Shivas (1960a) and need not be stressed here. The occurrence of diploid and tetraploid plants in at least two of the western species coupled with the possibility of hybridization between these species, suggests that the complex may be much more difficult of resolution in western North America than it has been in Europe. Further cytological study is needed to advance our understanding of these ferns.

ACKNOWLEDGMENTS

This paper stems from research undertaken for the masters degree at the Rancho Santa Ana Botanic Garden, Claremont, California. Thanks are extended to the Garden for the use of its facilities; to Drs. Peter H. Raven and Sherwin Carlquist for guidance at all stages of research; and to Homer Metcalf, Glenn Keator, and Dennis Breedlove for collections of living material.

LITERATURE CITED

KNOBLOCH, I. W. 1962. Tetraploid *Polypodium vulgare* var. *columbianum* from Arizona. Am. Fern Jour. **52:** 65–68.

MANTON, IRENE. 1950. Problems of Cytology and Evolution in the Pteridophyta. Cambridge Univ. Press.

———. 1951. Cytology of *Polypodium* in America. Nature **167:** 37–39.

SHIVAS, M. G. 1960a. Contributions to the cytology and taxonomy of species of *Polypodium* in Europe and America. I. Cytology. Jour. Linn. Soc. London (Bot.) **58:** 13–25.

———. 1960b. Contributions to the cytology and taxonomy of species of *Polypodium* in Europe and America. II. Taxonomy. Jour. Linn. Soc. London (Bot.) **58:** 27–38.

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A New Species of Phymatodes in the Phymatodes scolopendria Complex

SUNANDA PAL AND NIRANJAN PAL[1]

In recent years new taxa have been segregated from "species complexes" of ferns (Blasdell, 1956; Manton, 1958; Manton and Walker, 1953; Mehra, 1961; Mehra and Loyal, 1959; Mehra and Singh, 1957; Panigrahi and Manton, 1958; Sledge, 1960; Wagner, 1954; Wagner and Darling, 1957; Wagner and Hagenah, 1956; Walker, S., 1955; Walker, T. G., 1958) based on cytological and morphological characters. In a study of some polypodiaceous ferns, it was noted that *Phymatodes scolopendria* (Burm.) Ching [*Microsorium scolopendrium* (Burm.) Copel.] actually is a "species complex" containing two species (Fig. 1).

The original description of *P. scolopendria* by Burmann (1768), which is inadequate, reads: "*Polypodium scolopendria: frondibus lanceolatis integris trilobis & quinquelobis, sureulo repente.*" During the last two centuries the species has been described more critically, but unfortunately only to accommodate

[1]Research done in the Botany Department, Calcutta University.

two species as a single one. Material was examined from the Central National Herbarium of the Botanical Survey of India and in the Herbarium of the Royal Botanic Gardens, Kew, and in both cases two species were identified as *Phymatodes scolopendria* (Burm.) Ching.



FIGURE 1. PHYMATODES SCOLOPENDRIA (BURM.) CHING, a; P. BANERJIANA PAL & PAL, b.

Our materials were collected from the gardens of the Bose Research Institute, Calcutta, the Science College campus, Calcutta University, and the Indian Botanic Garden, Calcutta. Our observations are based chiefly on freshly collected specimens. In addition to examining the gross morphology of the two species, a detailed study of the anatomy, cytology, and gametophytes also has been made, and the comparative data are presented in Table 1. A critical study shows that the two are quite different and should be separated as distinct species. One of these closely corresponds with the descriptions of Burmann (1768) and Ching (1933). The other is described as *Phymatodes banerjiana*, in honor of our revered teacher, Dr. I. Banerji.

PHYMATODES **banerjiana** Pal & Pal, *spec. nov.*

Rhizoma longe repens, 5-9 mm. crassum fusco-viride ad intervalla lateraliter furcatum, vestitum squamis partim deciduis. Squamae rhizomaticae 2.5–4.0 × 0.3–0.8 mm., basi adpressae sordide nigro-brunneae concolores subulato-lanceolatae fere cordatae, peltatae ad basin vel pseudopeltatae clathratae, apice longe acuminato in cellulam amplam glandularem in statu juvenili desinente, marginibus plus minusve squarrosis praterquam ad basin glandularibus, basi fere rotunda vel inconspicue vel alte ad medium incisa, lobis fere aequalibus et altero alteri incumbentibus, pedunculo cylindrico pallide brunneo dorsaliter et perpendiculariter ad basin squamae in margine vel prope marginem affixo. Folia ornata squamis deciduis in stipitibus et laminis praesertim in nervis principalibus; squamae eis rhizomatis similes sed minores (2.0–3.5 × 0.2–0.3 mm); porro folia juvenilia capillis minutis haud furcatis vel breviter furcatis glandularibus praesertim in lamina ornata. Foliorum stipes phyllopodio prominente insidens 4-20 cm. longus castaneo-viridis vel castaneus nitentissimus. Lamina (5–) 9–11 (–17) -loba (raro integra vel paucíloba), 10–40 × 2–30 cm., herbacea fusce caeruleo-viridis niteus (praesertim in pagina superiore); foliorum segmenta 10–20 × 2.0–2.5 cm. lanceolata vel linearia plerumque latissima prope medium, terminale quidem lateralibus fere simile; apices vulgo longe acuminati; margines sparse sinuati recurvi; sinus segmenties ad 2.5–plo latior; incisurae usque ad 0.4–1.0 cm. ex nervo medio. Nervatio anaxetoidea; nervi principales prope basin castanei caeteri haud visibiles; areolae primariae in seriebus binis vel nonnumquam singulas in ambis lateribus segmentorum, eae costularum quidem multo maiores; areolae secundariae irregulares et minutae, nervulis capitatis inclusis; nervuli quoque ultra areolas primarias ad margines extendentes. Sori dispersi per totam paginam inferiorem in seriebus binis vel nonnumquam singulis ad utrumque latus cuiusque segmenti pleosorici; sori singuli in serie interna suppeditati in nervo prominente acroscopico et nonnullis anastomosantibus ex

nervo principali laterali prope eiusdem basin exeiunte; externa series sororum in areolis primariis submarginalibus. Sori elliptici (minores rotundi) 1–4 mm. diam., brunnei tenuiter immersi pagina superiore foliorum partim elevata. Sporangium fere sphaericum, 0.2 mm. latum; cellulae annulares 11–14–15 numero; cellulae stomii: epistomii cellulae binae vel ternae, cellulae labiales 4, hypostomii binae ternaeve; sporangii stipes circa 0.55 mm. longus. Sporae luteae liberae anisopolares bilaterales ellipticae aspectu polaris, scabrato-foveolatae, P:E = 5.2:8 magnitudinis sequentis: equatorialis 44 μ polaris 29 μ. Paraphyses filamentosae glandulares 4–5-cellulis longae. Rhizoma meristelis circa 16, foliorum basis circa 8 meristelis ornata; stomata circa 50 in singulis mm. quadr.

Holotypus in the National Herbarium of India, Sibpur, Calcutta, India, a plant of unknown source cultivated in Calcutta, collected August, 1957, *Pal & Pal* 14. An isotypus, *Pal & Pal* 14 (2), has been deposited in the herbarium of the Royal Botanic Gardens, Kew, England, and an authentic specimen, *Pal & Pal* 14 (3), collected Aug. 7, 1960, is preserved in the U. S. National Herbarium.

The major points of difference between the two species are given in Table 1.

TABLE 1.

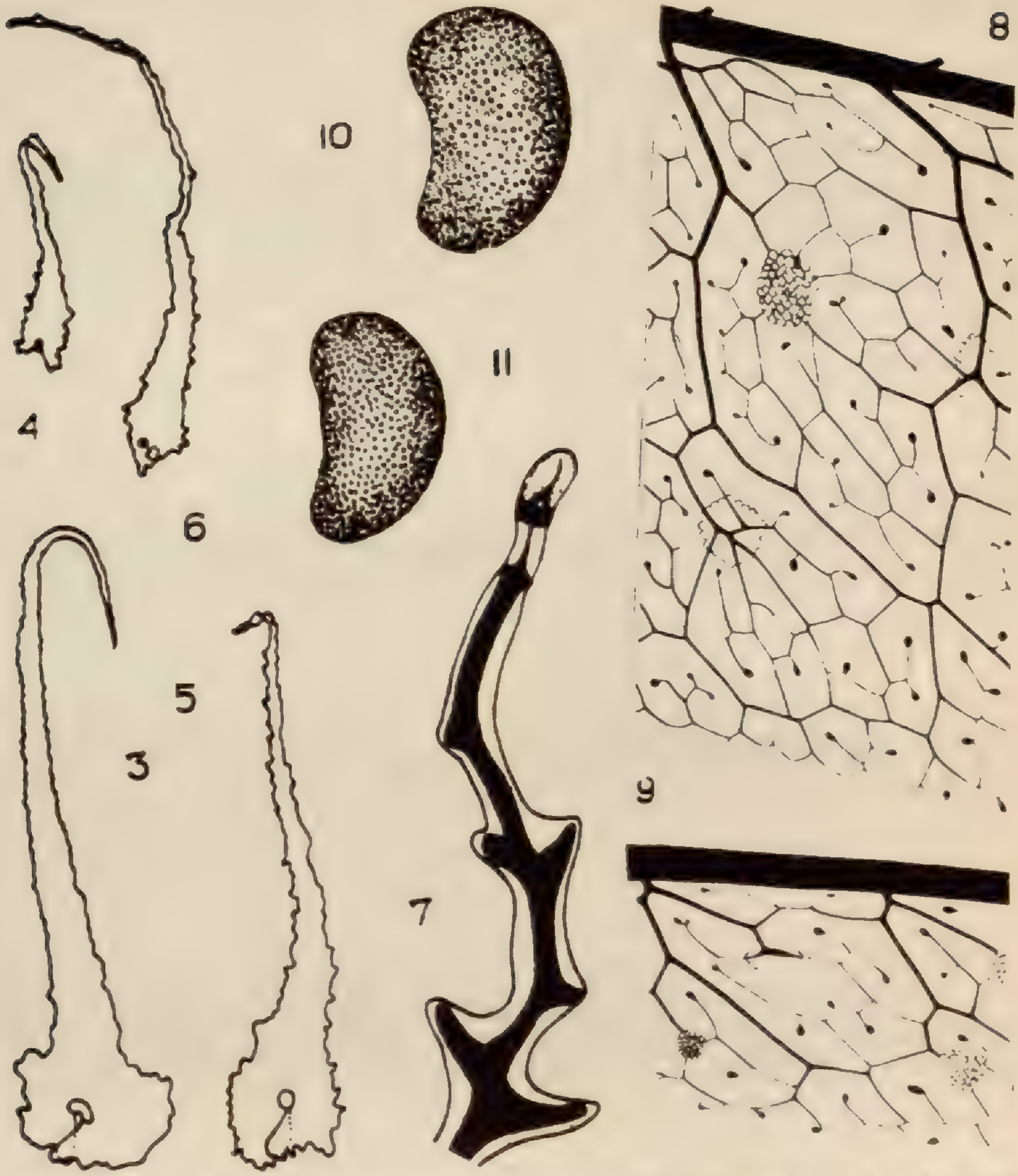
Characters	*P. scolopendria*	*P. banerjiana*
Diameter of rhizome	4–7 mm.	5–9 mm.
Average length of stipe and blade	35/30 cm.	20/30 cm.
Ratio of stipe to blade	1.15	0.66
Color of stipe	green or light chocolate-green, shiny	chocolate-green or chocolate, very shiny
Color of blade	green, upper surface shiny	dark bluish green, both surfaces shiny
Color of main veins	green, sometimes with chocolate tinge near base	chocolate toward base, green toward apex
Texture of blade	subcoriaceous	herbaceous
Thickness of blade	0.4 mm.	0.3 mm.
Frequency of stomata	97 per mm.^{2}	50 per mm.^{2}
Number of segments	1–*(3–5)*–9	1–*(9–11)*–17
Depth of incisions	1–3 cm. from midrib	0.4–1.0 cm. from midrib

Width of sinuses	to 1.5 times broader than segments	to 2.5 times broader than segments
Shape of lateral segments	margins nearly parallel from base to middle	broadest at middle
Character of terminal segments	always broader than lateral segments	similar to or rarely slightly broader than lateral ones
Average size of lateral segments	13 by 4 cm.	15 by 2 cm.
Number of rows of primary areoles	2–3	1–2
Nature of mature sori	2–6 mm. wide; orange-yellow; dictyosoric	1–4 mm. wide; brown; pleosoric
Number of bow cells	8–*(12)*–14	11–*(14)*–15
Number of stomial & separating (4) cells	3 + (4) + 3	2–3 + (4) + 2–3
Length of sporangial stalk	0.35 mm.	0.55 mm.
Diameter of sporangium	0.25 mm.	0.20 mm.
Spore size: equatorial/ polar measurements	34–*(47)*–54 μ / 25–*(32)*–36 μ	37–*(44)*–52 μ / 23–*(29)*–32 μ
Length and width of scales on rhizome	4–7 × 0.7–1.5 mm.	2.5–4.0 × 0.3–0.8 mm.
Length and width of scales on leaf	1–2 × 0.2–0.4 mm.	2–3.5 × 0.2–0.3 mm.
Average number of meristeles in rhizome/ base of leaf	21 / 10	16 / 8
Configuration of somatic chromosomes (36 pairs)	3 with satellites; 1 submedian pair; length, 2.9–6.5 μ	1 with satellites; no median or submedian pair; length, 2.9–5.7 μ
Prothallium	often elongated	never elongated

Retention of these two distinct species under *P. scolopendria* possibly was due to several reasons. The type specimen was not described adequately for a long time. [Holttum (1949) rightly remarked that most species of Polypodiaceae are described only in brief taxonomic formulae that are unsatisfactory]. In the light of the present investigation, it appears that some characteristic features of these two species previously were overlooked or differently interpreted, possibly because former workers depended only on dried herbarium specimens. In such material the original color of the leaves, scales, and other parts is lost. Color was found to be very important in this complex. Such deciduous structures as scales may fall, and epidermal hairs and paraphyses may be lost—even in nature. Moreover, microsco-



Figure 2. Rhizome, Types of leaves, Distribution of sori in Phymatodes scolopendria (2A —a, b, c): in P. banjeriana Pal & Pal (2B — a, b, c). Scale: a, b, ca. × 1/7; c, ca. × 1/2.



FIGURES 3, 4, 8, 10, PHYMATODES SCOLOPENDRIA: 3, RHIZOME SCALE; 4, LEAF SCALE; 8, VENATION; 10, SPORE. FIGURES 5-7, 9, 11, P. BANERJIANA: 5, RHIZOME SCALE; 6, LEAF SCALE; 7, APEX OF RHIZOME SCALE; 9, VENATION; 11, SPORE. SCALE: FIGS. 3-6, ca. × 14; 7, ca. × 175; 8-9, ca. × 4; 10-11, ca. × 440.

pic examination of scales from fresh material [to which Holttum (1954) gives much importance], and attention to the venation often reveals distinguishable features long unnoticed (Figs. 3-9).

The size and shape of the leaf varies considerably in both of these species, but especially in *P. scolopendria* (Fig. 2). In nature, however, they can be distinguished easily.

Phymatodes banerjiana is, however, very closely allied with *P. scolopendria*. It also shows much resemblance with *Polypodium alternifolium* Willd., which has been considered a synonym of *P. scolopendria*, but which is apparently different. We have seen photographs of the type of *P. alternifolium* from the Willdenow Herbarium, housed in the Botanisches Museum, Berlin-Dahlem, through the courtesy of Dr. D. E. Meyer and which were forwarded to us on loan by C. V. Morton, of the U. S. National Museum. These were collected by Klein in India. *Phymatodes banerjiana* differs from *Polypodium alternifolium* in having two irregular rows of sori at each side of the main vein of a lobe (rather than a single regular row), in the elliptical shape of the sori, and in more deeply incised lobes near the base.

Our thanks are due to Professor H. Santapau and Dr. S. E. Mukherjee, of the Botanical Survey of India, and to C. V. Morton of the U. S. National Museum, for valuable suggestions. We are grateful to Professor Santapau for preparing the Latin diagnosis.

LITERATURE CITED

BLASDELL, R. F. 1956. A Comparative Study of Hawaiian Species of the Fern Genus *Doodia*. Bull. Torrey Club **83:** 62-71.

BURMANN, N. L. 1768. Flora Indica. Lugduni Batavorum. 241 p.

CHING, R. C. 1933. Studies of Chinese Ferns. No. 11. Contr. Inst. Bot. Nat. Acad. Peiping **2:** 31-100.

HOLTTUM, R. E. 1949. The Classification of Ferns. Biol. Rev. **24:** 267-296.

———. 1954. The Classification of Ferns. The Present Position and Some Thoughts on Future Developments. Proc. VIII Int. Bot. Cong. Paris. Rep. & Comm. **4:** 5-8.

MANTON, I. 1958. The Concept of the Aggregate Species. Systematics Today. Uppsala Univ. Arsskr. **6:** 104-112.

———, and S. WALKER. 1953. Cytology of the *Dryopteris spinulosa* Complex in Eastern North America. Nature **171:** 1116-1117.

MEHRA, P. N. 1961. Cytological Evolution of Ferns with Particular Reference to Himalayan Forms. Presidential address, Indian Sci. Congr. Sec. Botany.

———————, and D. S. LOYAL. 1959. Cytological Studies in *Marsilea* with Particular Reference to *Marsilea minuta* L. Res. Bull. Panjab Univ. n. s. **10:** 357-374.

———————, and G. SINGH. 1957. Cytology of Hymenophyllaceae. Jour. Genet. **55:** 379-393.

PANIGRAHI, G. and I. MANTON. 1958. Cytological and Taxonomic Observations on Some Members of *Cyclosorus parasiticus* Complex. Jour. Linn. Soc. (Bot.) London **55:** 729-743.

SLEDGE, W. A. 1960. The Polypodiaceae and Grammitidaceae of Ceylon. Bull. Brit. Mus. Nat. Hist. Bot. **2:** 131-158.

WAGNER, W. H., JR. 1954. Reticulate Evolution in Appalachian Aspleniums. Evolution **8:** 103-118.

———————, and T. DARLING. 1957. Synthetic and Wild *Aspleninm gravesii*. Brittonia **9:** 57-63.

———————, and D. J. HAGENAH. 1956. A Diploid Variety in the *Cystopteris fragilis* Complex. Rhodora **85:** 79-87.

WALKER, S. 1955. Cytogenetic Studies in the *Dryopteris spinulosa* Complex. I. Watsonia **3:** 193-209.

WALKER, T. G. 1958. Hybridization in Some Species of *Pteris* L. Evolution **12:** 82-92.

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Ferns of Manitoulin Island, Ontario

JAMES H. SOPER

(Continued from page 81)

ASPLENIACEAE

28. ASPLENIUM RUTA-MURARIA L. var. CRYPTOLEPIS (Fern.) Wherry—In crevices of limestone cliffs and boulders 1 mile E of West Bay, 27 July 1952, *S & C 5710;* loc. cit., 26 July 1956, *S & F 6606;* damp crevices in shelving limestone cliffs, High Hill escarpment 2 miles S of Honora, 8 July 1957, *S & G 7265;* loc. cit., 12 Sept. 1962, *S & H 9515;* crevices along edge of low limestone ridge on summit of pavement NW of Silver Lake (just N of Ontario Paper Company's Ranger Station), 20 July 1959, *S & H 8897;* mossy crevices of large boulders at base of talus slope on east side of High Hill, NW of Rockville on west side of Manitou Lake, 12 Sept. 1961, *S & Co 9299.*

The American variety of Wall-Rue was collected on rocks at the "north end of Manitoulin Island" in August, 1901, by a Dr. Scott. A specimen was preserved in the National Herbarium (CAN #2154) and the fern was re-

ported as new to Canada in 1906 by J. M. Macoun (1906). Its rediscovery by C. O. Grassl in 1932 and by Soper & Clayson in 1952 has been reported by the author (1955). In addition to the original Scott collection, the following are the only collections seen from localities on Manitoulin Island: Battery Bluff [near Cook's Dock], *C. O. Grassl 1635* (DAO, MICH); Leask Bay, *W. Koelz 4160* (MICH). It seems likely that further exploration of similar habitats on the island will yield more stations of this rare fern. It has recently been rediscovered on Drummond Island in Chippewa County, Michigan: in crevice of a vertical, burnt-over, limestone cliff (Marblehead) facing Cockburn Island, Section 31, R8E, 1 Sept. 1961, *J. K. Hiltunen 3674* (TRT, WUD)—see Hiltunen (1962).

29. ASPLENIUM TRICHOMANES L.—On limestone boulders and in crevices of cliffs along shore of Manitou Lake about 1.5 miles E of Sandfield, 26 July 1952, *S & C 5668*; crevices of limestone along brow of escarpment on west side of Manitou Lake, 7 July 1953, *S & K 5871*; loc. cit., 12 Sept. 1961, *S & Co 9303*; rocky crevices on wooded ridge east of Windfall Lake, 4 July 1957, *S & G 7157*; in small pockets of limestone in shady woods 8 miles SW

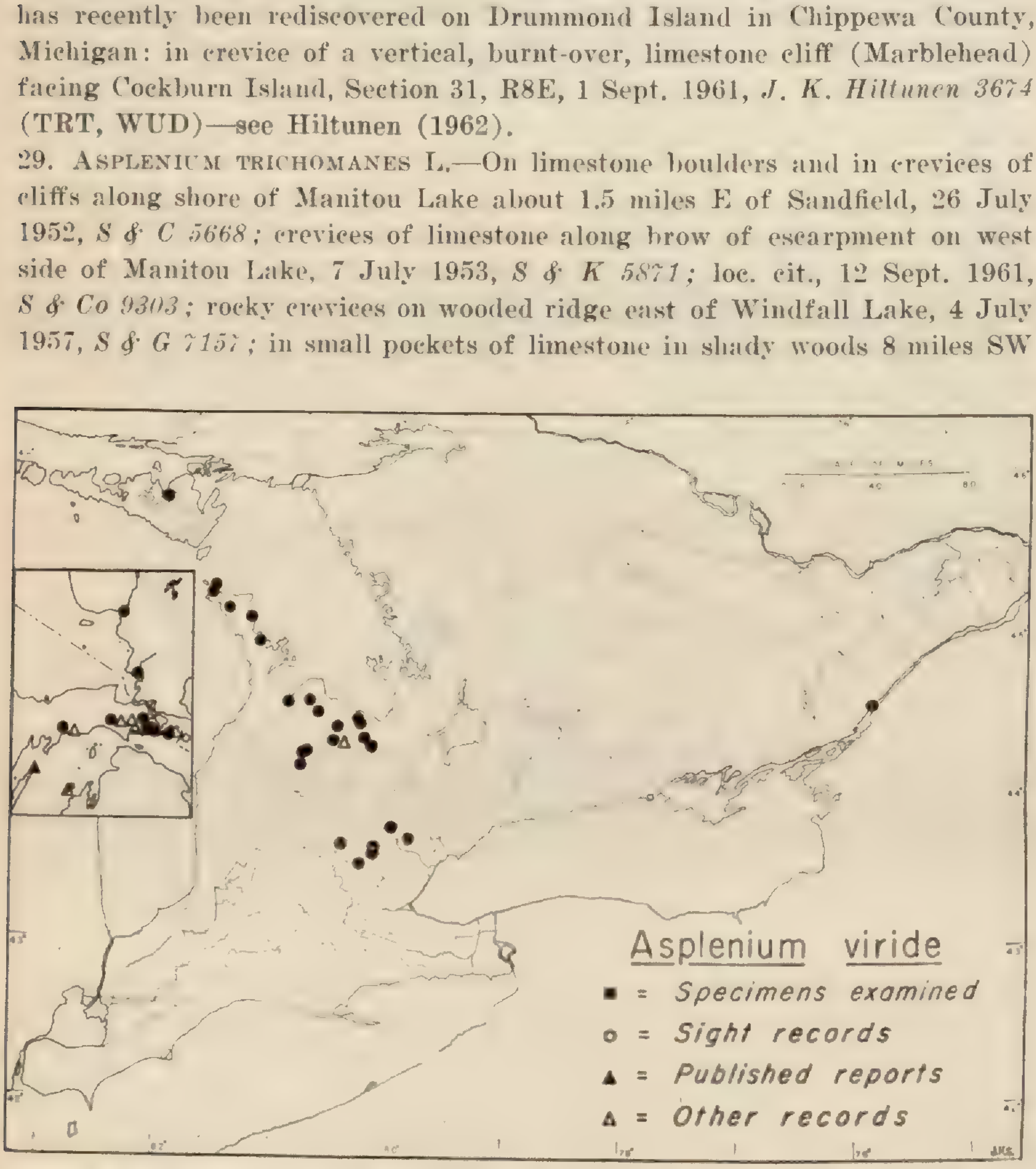


FIGURE 6. DISTRIBUTION OF ASPLENIUM VIRIDE IN SOUTHERN ONTARIO. INSET: RECORDS FOR PARTS OF NORTHERN MICHIGAN AND EASTERN LAKE SUPERIOR REGION.

of Manitowaning, 5 june 1959, *S & H 8446;* rocky ridge in clearing near Poole Lake, 19 June 1959, *S & H 8533;* crevices of limestone pavement NW of Silver Lake, 20 July 1959, *S & H 8928;* low limestone ridge in open woods near lighthouse on Mississagi Strait, 22 July 1959, *S & H 8946;* in crevices of boulders on wooded talus slope, High Hill, S of Honora, 12 Sept. 1962, *S & H 9514.* Sight records: Cook's Dock, Evansville, Green Bay, Ice Lake, Mindemoya, Mud Lake, Providence Bay, Silver Lake, South Baymouth.

Maidenhair Spleenwort is a common fern on the island and is often found in the vertical cracks of the numerous patches of limestone pavement. Other collections: Sounding Cove, Battery Bluff, Cockburn Is., and Rattlesnake Harbour, *C. O. Grassl 1656, 1657, 1658, & 5890* (MICH); Providence Bay, *W. Koelz 4066* (MICH); Michael Bay, *H. H. Brown 5606* (TRT); South Bay, *F. S. Cook 379* (UWO); Murphy Point, *Senn & Lindsay 5434* (DAO, TRT); High Hill, Excelsior, *N. C. Fassett 14595* (GH); near Tehkummah, *Pease & Ogden 25036* (GH).

30. ASPLENIUM VIRIDE Huds.—In crevices of cliff face at base of brow of escarpment, High Hill, S of Honora, 12 Sept. 1961, *S & H 9516, 9518, 9519.* This appears to be the first collection of this species from Manitoulin Island and provides an expected intermediate station between those along the upper part of the Niagara Escarpment on the Bruce Peninsula (see Fig. 6) and those in the area to the northwest, viz. Drummond Island, the eastern part of the northern peninsula of Michigan and the east shore of Lake Superior.

The Green Spleenwort was discovered for the first time in 1962 while investigating a trail called the "Cup and Saucer Trail" which has recently been opened for public use by the Manitoulin Tourist Association. This trail leads to the summit of High Hill, ending at the triangulation station set up by the Geological Survey, and passes close to several stands of the Green Spleenwort, the Wall-Rue and the Walking Fern.

31. CAMPTOSORUS RHIZOPHYLLUS (L.) Link—On large mossy boulders and blocks of talus at base of escarpment on east side of High Hill, NW of Rockville on the west side of Manitou Lake, 12 Sept. 1961, *S & Co 9300;* on mossy boulders at base of cliffs, north side of High Hill S of Honora, 12 Sept. 1962, *S & H 9524.* The Walking Fern was first seen in this locality on 7 July 1953 but no specimens were taken. When it was realized that no other records existed for the island, a voucher specimen became essential and a return to the area revealed numerous colonies along the talus slope. The Manitoulin localities are the northernmost for Ontario and although this species is common along the Niagara Escarpment from the Niagara River to near Lion's Head in the Bruce Peninsula, I have found no records for the northern part of the Bruce. The known Ontario distribution is shown on the map in Fig. 7.

POLYPODIACEAE

32. POLYPODIUM VULGARE L. var. VIRGINIANUM (L.) Eaton (*P. virginianum* L.)—On limestone along brow of escarpment on west side of Manitou Lake, 7 July 1953, *S & K 5870;* loc. cit., 12 Sept. 1961, *S & Co 9307;* along rocky ledges of escarpment in woods, Battery Bluff, 15 Sept. 1954, *S & D s.n.* (TRT #116264); on top of limestone boulder in moss, rocky woods, Mud Lake, 5 July 1957, *S & G 7165;* low limestone ridge in open woods NW of Silver Lake, 20 July 1959, *S & H 8944;* on quartzite ridge in open field, 3 miles W of Sheguiandah, 15 Sept. 1962, *S & H 9580.* Great Duck Is.: on old fallen tree trunk in dense woods along E-W transect from Gravel Harbour to Horseshoe Bay, 23 June 1959, *S & H 8582.* Sight records: Evansville, Green Bay, High Falls, High Hill 2 miles S of Honora, Ice Lake, Manitou Lake, 5 miles SW of Manitowaning, Mindemoya, Mississagi Strait, Perch Lake, Poole Lake, Providence Bay, Sounding Cove, Ten-mile Point, West Bay, Windfall Lake; Birch Is.; Whitefish Falls; Baie Fine; Killarney.

Polypody is one of the commonest ferns in the district and occurs both on the basic rocks of the island and on the quartzites and other acidic rocks

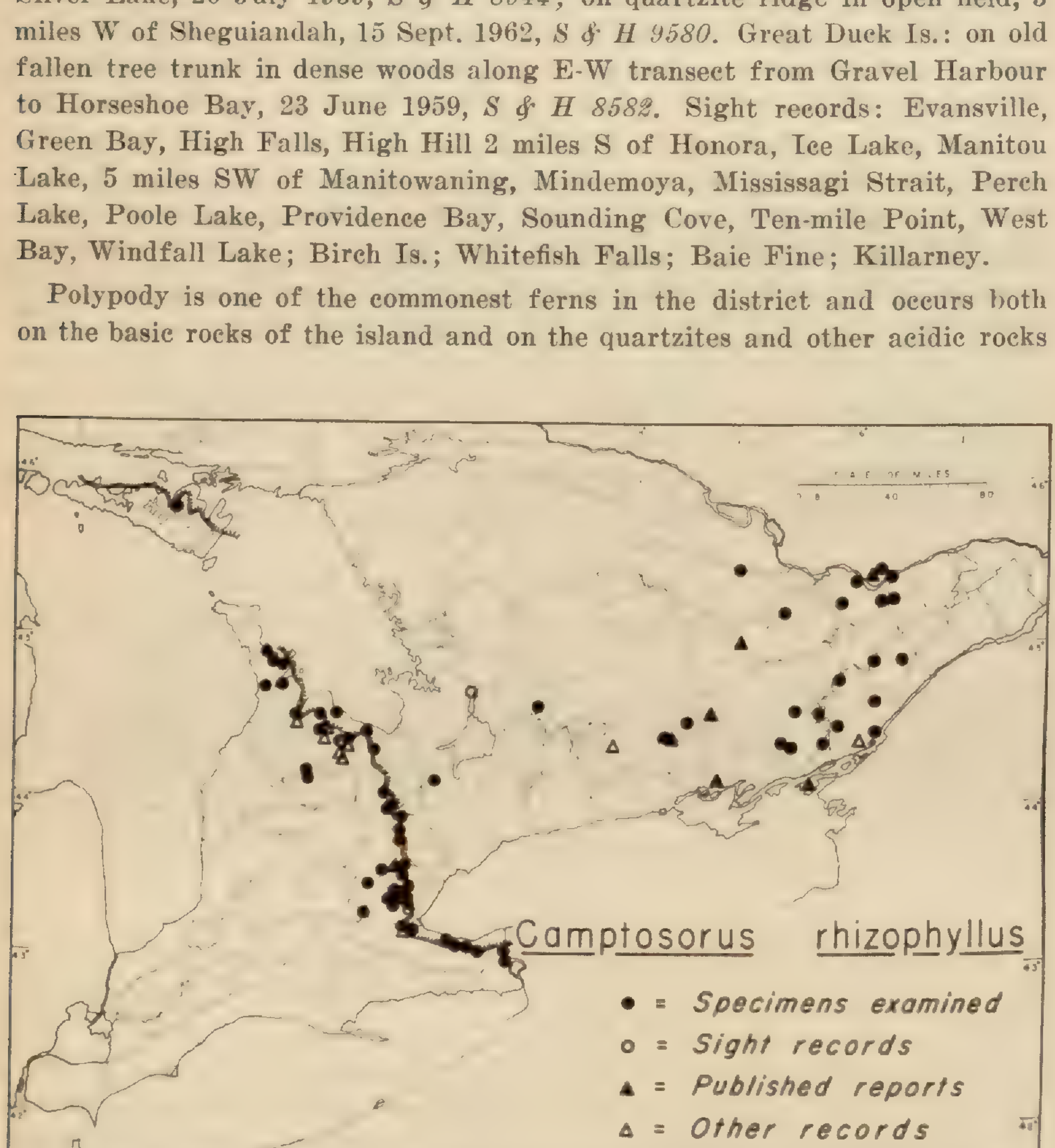


FIGURE 7. DISTRIBUTION OF CAMPTOSORUS RHIZOPHYLLUS IN ONTARIO. THE HACHURED LINE INDICATES THE ONTARIO PART OF THE NIAGARA ESCARPMENT.

of the mainland and of the Sheguiandah area. Other collections: Great Cloche Island opposite Little Current, S of Little Current, Cockburn Is., Great Duck Is., Providence Bay, and Leask Point, *C. O. Grassl 1659, 1660, 1661, 1662, 5856, & 5872* (MICH); Michael Bay, *H. H. Brown 5608* (TRT); McKim's Beach, *K. K. Irizawa 133* (TRT); 10 miles S of Sheguiandah and Murphy Point, *Senn & Lindsay 5342 & 5435* (DAO). Reported from McLeod Harbour on Cockburn Island by Bell (1870) and from South Baymouth by Mrs. E. G. Sibley (personal communication).

LYCOPODIACEAE

33. LYCOPODIUM ANNOTINUM L.—In damp woods near shore, Frechette Bay, 25 July 1959, *S & H 8992*; damp coniferous woods along Manitou River near Michael Bay, 14 Sept. 1961, *S & Co 9329*. Great Duck Is.: damp woods at S end of island, 10 July 1953, *S & K 5889*; loc. cit., 10 July 1957, *S & G 7407*; clearing on wooded gravel ridge just N of main E-W trail across island, 28 June 1959, *S & H 8704*. Sight records: Bluejay Creek, Dean Bay, Mississagi Strait, Portage Bay, Silver Lake, Silverwater; Cockburn Is.; Western Duck Island.

The Bristly Club-moss is widely distributed and locally abundant in some areas. Other collections: Great Duck Is., Cockburn Is., and Providence Bay, *C. O. Grassl 1487, 1489, & 5840* (MICH); Dean Bay, *J. Budd* (TRT #127909).

34. LYCOPODIUM CLAVATUM L.—Under cedars (*Thuja*) in shade, Christina Bay, 19 July 1959, *S & H 8867*; damp coniferous woods along Manitou River near Michael Bay, 14 Sept. 1961, *S & Co 9330*; Great Duck Is.: damp woods at south end of island, 10 July 1953, *S & K 5914*; open maple woods N of the main E-W trail across island, 28 June 1959, *S & H 8702*. Sight records: Bluejay Creek, Frechette Bay, 2–3 miles NW of South Baymouth, High Hill S of Honora, Mississagi Strait, Roberts Bay to Thomas Bay, Silver Lake, Silverwater; Cockburn Is.; NE corner of Great Duck Is.; Whitefish River Indian Reserve.

The Running Club-moss is occasional on the islands and more common on the mainland. Other collections: Cockburn Is., Great Duck Is., and Rattlesnake Harbour, *C. O. Grassl 1490, 5828, & 5847* (MICH); Michael Bay, *H. H. Brown 5603* (TRT); Portage Bay, *J. Budd* (TRT #127909).

35. LYCOPODIUM COMPLANATUM L. var. FLABELLIFORME Fern.—I have seen this variety of Ground Cedar in only one locality: 5 miles W of Manitowaning, 18 June 1959, in company with C. E. Heidenreich, but no voucher was taken. Apparently it is rare on Manitoulin Island and only two other localities are known from specimens examined, as follows: road to Belanger Bay about 2 miles W of Burnt Island Road and road to Portage

Bay, *J. Budd* (TRT #127908 & 127910). A collection made near the Government Road south of Mindemoya, Sept. 1961, *Mrs. Roy Williamson*, (TRT #132435), which is referred here temporarily, approached *L. tristachyum* Pursh, but no typical material of the latter species has yet been seen from Manitoulin.

36. LYCOPODIUM LUCIDULUM Michx.—In beech-maple woods N of Silverwater, 29 July 1959, *S & H 9038;* in damp rocky woods near shore of small lake about one mile SE of Billings, 12 Sept. 1962, *S & H 9523*. Great Duck Is.: in damp *Taxus* thickets at NW corner of island, 11 July 1957, *S & G 1351;* on hummocks in dense maple woods just north of main E-W trail across island, 28 June 1959, *S & H 8705*. Sight records: Christina Bay, Cook's Bay, Frechette Bay, W side of Manitou Lake, Mississagi Strait, Silver Lake; Cockburn Is.; Inner Duck and Middle Duck Islands.

The Shining Club-moss is occasional and rarely found in abundance in the district. Other collections: Cockburn Is., *C. O. Grassl 1498* (MICH).

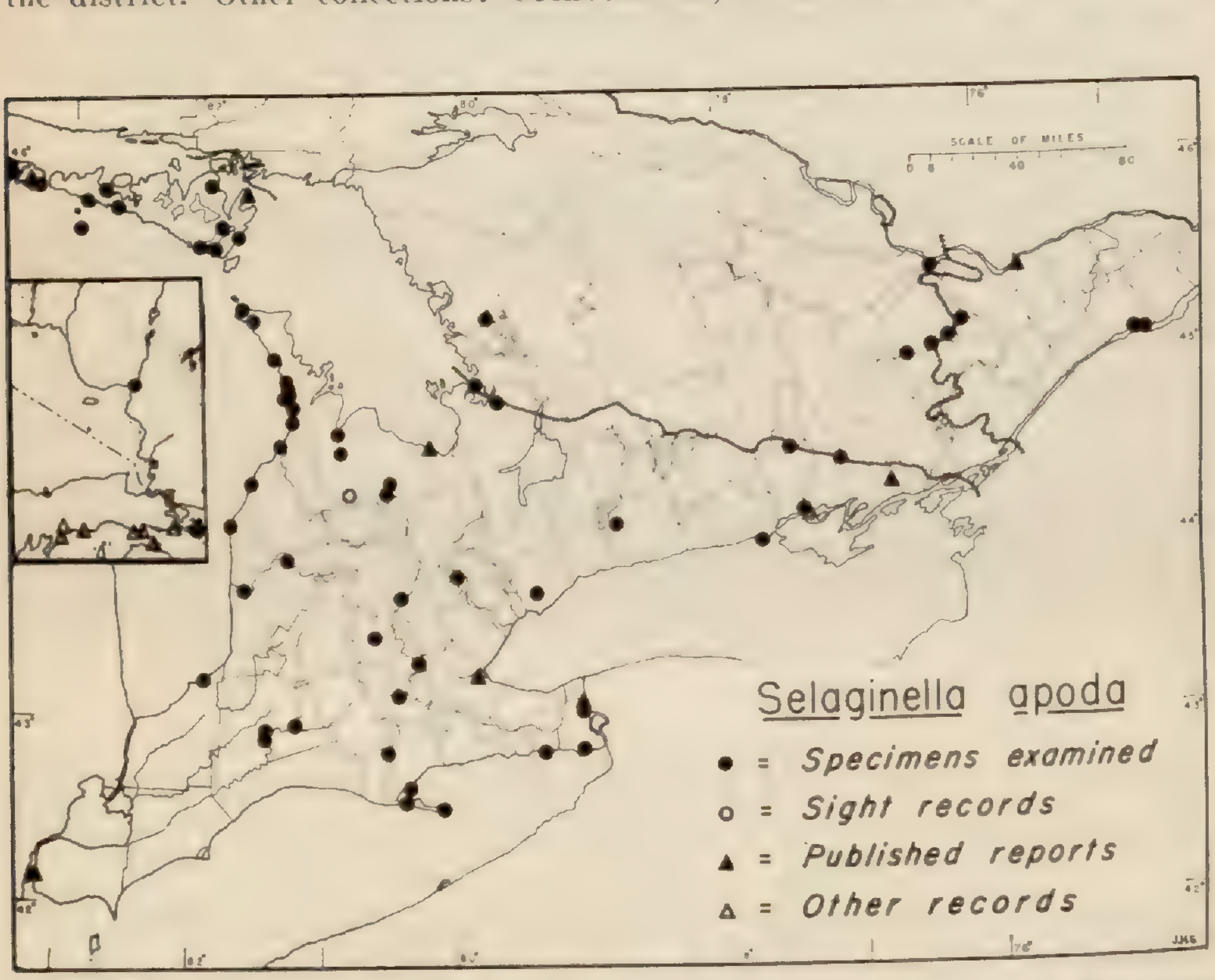


FIGURE 8. DISTRIBUTION OF SELAGINELLA APODA IN SOUTHERN ONTARIO. INSET: RECORDS FOR PARTS OF NORTHERN MICHIGAN AND THE EASTERN LAKE SUPERIOR REGION. LINES WITH SPACED DOTS INDICATE CONTACT BETWEEN PRECAMBRIAN AND PALEOZOIC BEDROCKS.

This species was reported from near Killarney and Grondine Point by Klugh (1913).

37. LYCOPODIUM OBSCURUM L. var. DENDROIDEUM (Michx.) D. C. Eaton—In beech-maple woods N of Silverwater, 29 July 1959, *S & H 9050*; damp coniferous woods along Manitou River near Michael Bay, 14 Sept. 1961, *S & Co 9328*. Great Duck Is.: rocky woods at S end of island, 10 July 1953, *S & K 5912*; in damp thickets of *Taxus* at NW corner of island, 11 July 1957, *S & G 7352*; shady maple woods N of main E-W trail across the island, 28 June 1959, *S & H 8703*. Sight records: Blue-jay Creek, Perch Lake, Providence Bay, Roberts Bay to Thomas Bay; Cockburn Is.; 2 miles S of Whitefish Falls.

The Ground Pine is occasional and rarely found in abundance in the district. Other collections: Great Duck Is.: *C. O. Grassl 5827*, *W. Koelz 4551* (MICH); road to Big Bay, Tehkummah Tp., *J. Budd* (TRT #127896). This variety was also reported from an island off Grondine Point by Klugh (1913).

SELAGINELLACEAE

38. SELAGINELLA APODA (L.) Fern.—On damp sandy shore among pebbles, Thomas Bay, 6 July 1957, *S & G 7225*; damp sand near beach, Christina Bay, 19 July 1959, *S & H 8846*. Great Duck Is.: damp soil and moss along upper beach, Horseshoe Bay, 23 June 1959, *S & H 8612*. Sight record: Frechette Bay.

This species is found only around the shores of Manitoulin and neighbouring islands although it has numerous inland stations in some parts of Southern Ontario south and east of Manitoulin (see map, Fig. 8). It is almost entirely absent from the main portion of the Canadian Shield, which suggests a preference for basic soils. Other collections: Frost Point, Tamarack Point, Leask Point, Rickett Harbour on Cockburn Island, and Cook's Bay, *C. O. Grassl 1950, 5835, 5846, 6346, & 6453* (MICH); Murphy Point, *H. A. Senn 6041* (DAO); South Baymouth, *Pease & Ogden 24863* (GH); Whiskey Is. [now William Is.], *J. Bell* (CCO).

39. SELAGINELLA RUPESTRIS (L.) Spring—Clearing in rocky woods, Sheguiandah, 26 July 1956, *S & F 6641*; first seen at this locality on 29 August 1949.

The Rock Spikemoss occurs on hard white bedrock (quartzite) at an archaeological site formerly used as an implement-chipping ground by the early Indians. The geological map for Manitoulin Island shows this area as one of the few Precambrian exposures in the region related to the type of rock which occurs on the mainland in the Cloche Mountains and in the Killarney district. The distribution map (Fig. 9) shows that this species is found chiefly in the Precambrian region. Occurrences outside this region

are usually on sandy soil instead of the more common rocky habitat. Only two other collections have been seen: [La] Cloche Peninsula, *Fernald & Pease 3062* (CAN,GH,TRT); south of Little Current, *Fernald & Pease 3063* (GH).

40. SELAGINELLA SELAGINOIDES (L.) Link—In moist sand along shore of Christina Bay, 19 July 1959, *S & H 8859;* damp shady woods at edge of beach near lighthouse, Mississagi Strait, 22 July 1959, *S & H 8937*. Sight record: Frechette Bay.

This species is restricted to the shore of Manitoulin and occurs in sandy or moist semi-wooded habitats. It is also found along the western side of the Bruce Peninsula (see map, Fig. 10) and at one location on the Georgian Bay shore. The distribution map for the Lake Huron-Georgian Bay region adds considerably to the range as published by McVaugh (1953) for Michigan, Wisconsin and adjacent Ontario. It is possible that the lake currents have been responsible to some extent for the spread of this species. Other collections: Helen Bay, Tamarack Point, Boom Point on Cockburn Island,

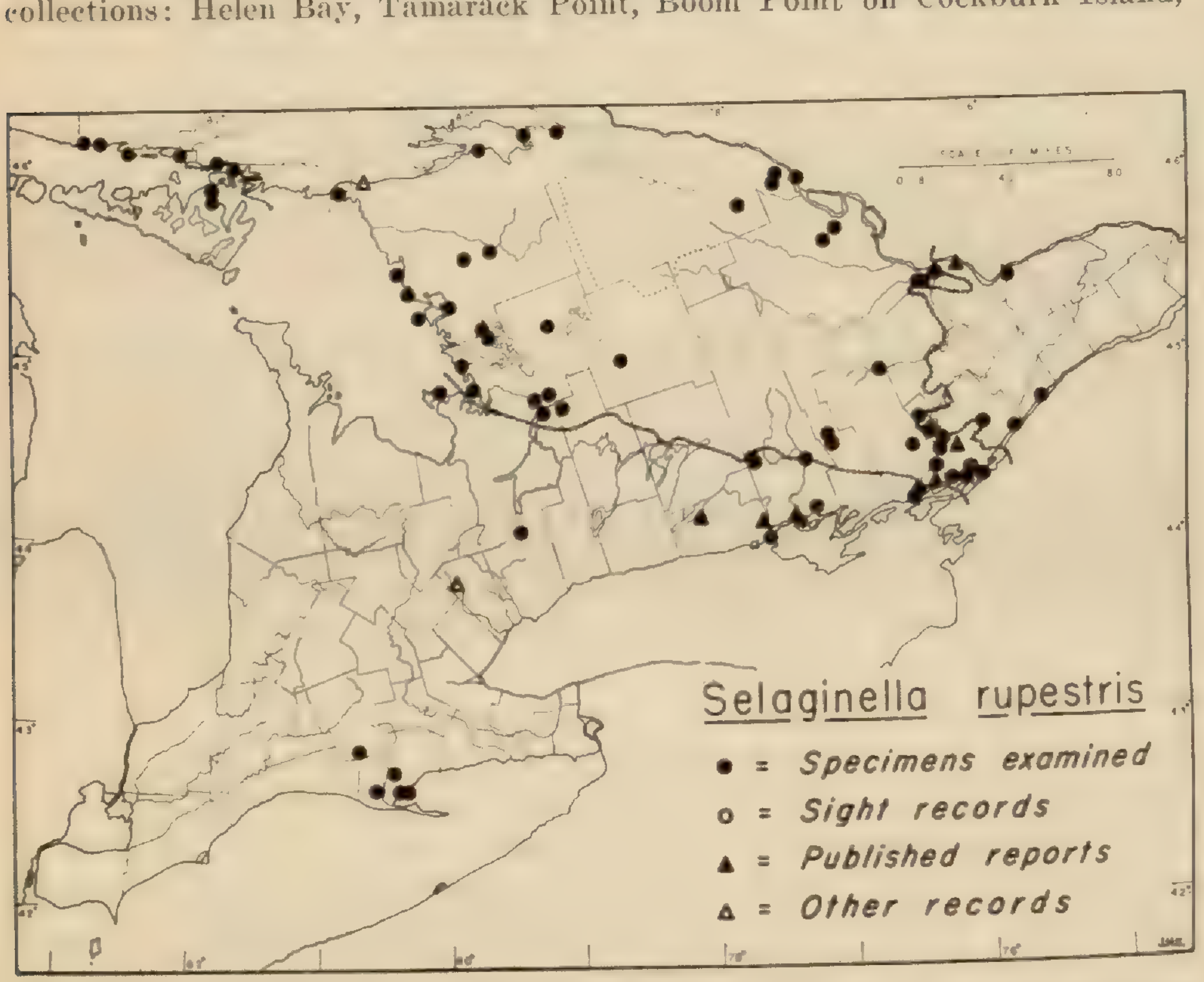


FIGURE 9. DISTRIBUTION OF SELAGINELLA RUPESTRIS IN SOUTHERN ONTARIO. LINES WITH SPACED DOTS INDICATE CONTACT BETWEEN PRECAMBRIAN AND PALEOZOIC BEDROCKS.

and Wikwemikong, *C. O. Brassl 1953, 5834 6136 & 6459* (MICH); Indian village at South Bay, *W. Koelz 4116* (MICH). Reported from Wekwemikongsing by Klugh (1913).

ISOETACEAE

41. ISOETES MURICATA Dur.—The Quillwort is known from a single collection in the Manitoulin District as follows: in 1–8 inches of water in sandy cove just beyond the NW end of the harbour at Little Current, 28 July 1932, *C. O. Grassl 1450* (MICH, as *I. echinospora*). The absence of *Isoëtes* from areas in Ontario outside the Precambrian Shield has been noted by Soper & Rao (1958).

EQUISETACEAE

42. EQUISETUM ARVENSE L.—In low wet cedar woods along shore of Perch Lake, 8 July 1957, *S, G, & D 7257;* along trail to Poole Lake, 19 June 1959, *S & H s.n.* (TRT #124677); in sand along beach at N end of Great Duck Is., 9 July 1953, *S & K 5959.* Sight records: Bluejay Creek, Cape Robert, Christina Bay, Gore Bay, Honora, Providence Bay, Silver Lake; Cockburn Is.; Inner, Middle and Outer Duck Islands.

The Field Horsetail is common in the district. Other collections: Wekwemikongsing, Sounding Cove, Indian village at South Bay, Leask Point and Rattlesnake Harbour, *C. O. Grassl 1463, 1470, 5820, 5845 & 5848* (MICH).

43. EQUISETUM FLUVIATILE L.—Shallow water in clearing of swampy woods, Mud Lake, 5 July 1957, *S & G 7184;* shallow water at edge of Perch Lake, 8 July 1957, *S, G, & D 7246;* floating sedge mat at edge of Poole Lake, 19 June 1959, *S & H 8545;* shallow water of beaver pond, S of Silver Lake, 29 July 1959, *S & H 9055.* Cockburn Is.: ditch along road at edge of woods, 3 miles SW of Tolsma Bay, 10 June 1959, *S & H 8506.*

The Water Horsetail is occasional to common in the area. Other collections: Wikwemikong, Gore Bay, and Leask Bay, *C. O. Grassl 1464, 1469, & 4177* (MICH); Lake Mindemoya, *Jenkins & Dalton 7670* (OAC).

44. EQUISETUM HYEMALE L.—In damp sand along shore of Providence Bay, 9 July 1957, *S, G, & D 7295;* sandy soil along trail through woods, Manitou River near Michael Bay, 14 Sept. 1961, *S & Co 9341.* Great Duck Is.: on dry sand in hollow between dunes, Desert Point, 22 June 1959, *S & H 8568.* Sight records: Mindemoya, Sounding Cove; Cockburn Is.

The Scouring-rush is occasional but may be locally abundant. Other collections: Cockburn Is., *C. O. Grassl 5837* (MICH). Also reported from Gore Bay by Bell (1870). My collections may be referred to var. *pseudo-hyemale* (Farw.) Morton.

45. EQUISETUM LAEVIGATUM A. Br., sensu C. V. Morton in Britton & Brown, Ills. Fl., vol. 1, p. 14 (1952), not R. L. Hauke in Amer. Fern Jour.

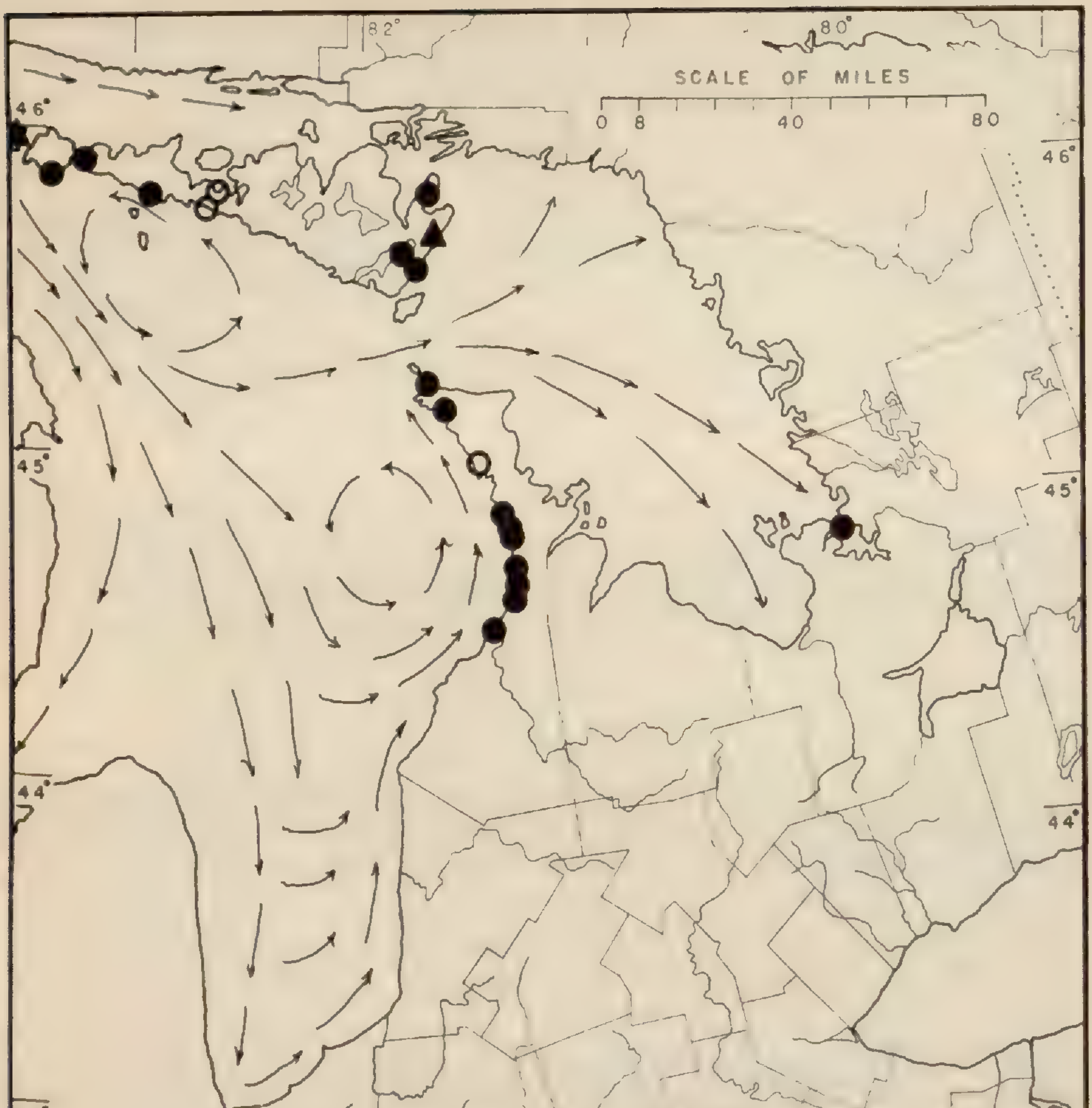


Figure 10. Distribution of Selaginella selaginoides in the Lake Huron and Georgian Bay region. Arrows indicate directions of currents

50: 192 (1960).—On sandy beach at Providence Bay, 27 July 1952, *S & C 5703;* loc. cit., 25 June 1961, *S & M 9219.* Great Duck Is.: damp sandy soil at N end of island, 9 July 1953, *S & K 5942.*

This species is not common in the area. Other collections: Providence Bay and Desert Point, *C. O. Grassl 5817 & 5829* (MICH); Cockburn Is., *J. Bell* (CCO).

46. EQUISETUM NELSONII (A. A. Eaton) Schaffner—Three collections have been referred to this taxon by R. L. Hauke, [who (1961) considers it as a hybrid between *E. laevigatum* and *E. variegatum*] as follows: Providence Bay and Leask Point, *C. O. Grassl 5839 & 5844a* (MICH); Leask Bay, *W. Koelz 4159* (MICH).

47. EQUISETUM PALUSTRE L.—I have not found the Marsh Horsetail in the district but I have seen two collections as follows: Cook's Bay and Providence Bay, *C. O. Grassl 1468 & 5838* (MICH).

48. EQUISETUM PRATENSE Ehrh.—In sandy soil of coniferous woods along Manitou River near Michael Bay, 14 Sept. 1961, *S & Co 9327.* Sight records: Bluejay Creek, Gore Bay, Silver Lake, Silverwater; Cockburn Island; SE corner of Great Duck Island.

This species is rare and local and I have seen no other collections from the district.

49. EQUISETUM SCIRPOIDES Michx.—In moist cedar woods near trail to shore at Christina Bay, 19 July 1959, *S & H 8822.* Sight records: East Bluff at Gore Bay, NW of Silver Lake.

The Dwarf Scouring-rush is comparatively rare. Other collections: near Sounding Cove, Wikwemikong, Providence Bay, and Cockburn Island, *C. O. Grassl 1466, 1467, 5816, & 5833* (MICH). Reported from Gore Bay by Bell (1870) and from near Killarney by Klugh (1913). Also reported from lots 8 & 9, concession B, Tehkummah Tp., by J. Budd of South Baymouth (personal communication).

50. EQUISETUM SYLVATICUM L.—In low damp woods around small lake N of Silverwater, 29 July 1959, *S & H 9042.* Sight records: Owl Lake, 2–3 miles NW of South Baymouth, and 2 miles S of Whitefish Falls.

The Wood Horsetail is comparatively rare in the area. Other collections: Cockburn Island and near Sounding Cove, *C. O. Grassl 1461 & 1465* (MICH). Reported from Gore Bay by Bell (1870).

51. EQUISETUM VARIEGATUM L.—In damp sand along shore of Christina Bay, 19 July 1959, *S & H 8858.*

This species is rare and local in the district. Other collections: near Indian village at South Bay, Cockburn Island, and Leask Point, *C. O. Grassl 5815, 5832, & 5844b* (MICH); S shore of Centre Island, *E. C. & E. B. Ogden 2392* (DAO, GH, NYS); Great Cloche Is., *Pease & Bean 26236* (GH).

EXCLUDED RECORDS

CRYPTOGRAMMA CRISPA (L.) R. Br. var ACROSTICHOIDES (R. Br.) Clarke—This fern was reported from McLeod's Harbour, Manitoulin Island, by Macoun (1890) on the authority of John Bell. I have not found a specimen in Bell's collection and in the original list published by Bell (1870) it is not listed. Instead, Bell listed *Cryptogramma stelleri* (as *Allosorus gracilis*), the latter not reported by Macoun (loc. cit.) from McLeod's Harbour. This suggests that an error in transcription was made when the records were being compiled for Macoun's Catalogue.

McLeod's Harbour is on the southeast side of Cockburn Island, just west of Manitoulin Island, and in this region the rock exposures are the typical limestones and dolomites. This is the correct habitat for *Cryptogramma stelleri* as it is found in similar sites on Manitoulin Island and on the Bruce Peninsula, but I have not seen or heard of *C. crispa* var. *acrostichoides* occurring on basic rocks. It seems likely also that Macoun's report of the latter species was the basis for Fernald's records for the Lake Huron region of Ontario (see Rhodora **37:** 245, map 12, and also p. 246, where the range is given as including "islands of Lake Huron, Ontario"). In the absence of a voucher it seems advisable to exclude this species from the flora of the Manitoulin Islands.

THELYPTERIS NOVEBORACENSIS (L.) Nieuwl. [*Dryopteris noveboracensis* (L.) Gray]—The New York Fern was reported from Gore Bay by Bell (1870) but I have not found a specimen in his collection which could be the basis for this report. There is one specimen (#411) labelled as this species but the locality given is Owen Sound and the sheet is a mixed collection of *Cystopteris* and another fern (sterile) which is not New York Fern. In the absence of a voucher it is better to exclude *T. noveboracensis* from the list of accepted species.

POLYSTICHUM LONCHITIS (L.) Roth—The Holly Fern has never been reported from Manitoulin Island although, on the basis of an earlier study of the range of this species and the next (1954), I believe it is to be expected there. There are two specimens in the Bell collection (#408, #447) which have been labelled "Manitoulin Island" but I am not prepared to accept these as authentic for several reasons. John Bell collected Holly Fern along with Hart's-Tongue Fern at Owen Sound during his stay there before the expedition to Manitoulin began. There is a reference to this in the text and Bell (1870) listed only Owen Sound and no other locality for this rare fern (as *Aspidium lonchitis*). Two specimens of *P. lonchitis* (#416, #415) have a scrap of paper bearing a handwritten notation "Owen Sound, July 12, 1866" but several apparent duplicates as well as the other two numbers cited above lack original data. I believe that if these ferns

had been seen or collected on Manitoulin or on any of the other islands in Lake Huron the localities would have been mentioned in Bell's list.

PHYLLITIS SCOLOPENDRIUM (L.) Newm. var. AMERICANA Fern.—The distribution of Hart's-Tongue in Ontario was studied in detail by the author (1954) and no authentic material was seen from Manitoulin Island. Maxon (1900) published a reported occurrence of this species on Manitoulin but had not seen a specimen from the area. In Bell's collection there are two specimens and several duplicates (#409, #415) of this fern labelled Owen Sound and one sheet of the first number has an original scrap of paper bearing the date and locality. There are also three other collections and several duplicates labelled "Manitoulin Island" (#402, #407, #448). Only one of these, a duplicate of No. 407 (TRT #132665) has a scrap of paper with the handwritten notation "Mississagi Isd., Lake Huron, July 20th, 1866, J. W. Bell." This island is in the North Channel near Blind River in the District of Algoma. As in the case of *Polystichum lonchitis*, I believe that the discovery of *Phyllitis* on Manitoulin or on any other island in the Lake Huron region would have been recorded in Bell's list (1870) where special mention is made (under *Scolopendrium officinarum*) of the habitat at the single locality southwest of Owen Sound where Bell is known to have collected Hart's-Tongue. It is possible that numerous duplicates were taken on several occasions at the Owen Sound locality and some of these, lacking individual labels, have been assumed to have come from Manitoulin. As yet there is no proof that *Phyllitis* has ever been collected on Manitoulin Island.

ACKNOWLEDGMENTS

Dr. R. M. Tryon of the Gray Herbarium of Harvard University has kindly checked the determinations of many of my own collections and has identified critical material of *Botrychium*, *Woodsia*, and *Dryopteris*. Mr. Dale J. Hagenah, of Birmingham, Michigan, has provided both personal records and data from the Cranbrook Institute herbarium for the distribution in the northern peninsula of Michigan of those species which have been mapped. Drs. Rogers McVaugh and Edward G. Voss of the University of Michigan have made available unmounted Grassl & Koelz specimens from Ontario as well as information on the geographical locations of areas visited by those two collectors in the upper Great Lakes region. Mr. Jarl K. Hiltunen of the U. S. Fish and Wildlife Service, Ann Arbor, Michigan, has made

available details concerning his recent discoveries of rare ferns on Drummond Island.

I am very grateful to the Ontario Department of Lands and Forests for facilities and assistance provided at the Fisheries Research Station at South Bay, in particular to Dr. F. E. J. Fry and the late John Budd for their interest and co-operation. Mr. John Walker of the Ontario Paper Company, Gore Bay, made possible the visit to Cockburn Island and access to privately owned areas at the western end of Manitoulin Island. The funds for field expenses and for the salaries of student assistants have been provided by the Grants-in-Aid of Research awarded by the University of Toronto.

SUMMARY

Manitoulin Island is situated in the northern part of Lake Huron and is part of the District of Manitoulin in the Province of Ontario, Canada. Its flora is significant because geographically and geologically the island is a link between the Bruce Peninsula of Ontario and the Upper Peninsula of Michigan. The flora is not well known, the only catalogue being the one by Dr. John Bell (published in 1870), which contains a list of plants collected on the Manitoulin Islands in 1866. Nineteen pteridophytes were recorded by Bell from localities on Manitoulin.

The annotated list of pteridophytes contained in this paper gives habitat data, specimen citations, sight records, published reports and general notes on distribution and abundance. By field work and an examination of specimen in other herbaria, the known fern flora has been increased to fifty-one taxa. Maps are included for ten species, showing their distribution in Southern Ontario or in the Great Lakes region. A reference map of Manitoulin Island shows the location of the author's collection localities and a gazeteer gives the latitude and longitude for place names. The discovery of *Asplenium viride*, *Camptosorus rhizophyllus*, *Dryopteris filix-mas* and *Woodsia ilvensis* on the island appears to constitute the first record for these species

and a notable range extension for Ontario. One new combination is proposed in the genus *Gymnocarpium*.

LITERATURE CITED

BELL, JOHN. 1870. On the Plants of the Manitoulin Islands. Appendix to Report of Progress from 1866–1869,, Geol. Surv. Can., pp. 449-469.

HAUKE, R. L. 1962. A Resume of the Taxonomic Reorganization of *Equisetum*, Subgenus *Hippochaete*, IV. Amer. Fern Jour. **52:** 123-130.

HILTUNEN, J. K. 1962. Rediscovery of the Wall-Rue in Michigan. Brittonia **14:** 120.

KLUGH, A. B. 1913. Notes on the Plant Formations of the Shores of Georgian Bay. Ont. Nat. Sci. Bull., no. 8, pp. 13-31.

MACOUN, JAMES M. 1906. Contributions to Canadian Botany—XVII. Ottawa Nat. **20:** 135-143.

MACOUN, JOHN. 1890. Catalogue of Canadian Plants, Part V. Acrogens. Montreal.

MAXON, W. R. 1900. On the Occurrence of the Hart's-Tongue in America. Fernwort Papers, pp. 30-46.

MCVAUGH, ROGERS. 1953. Remarks on the Occurrence of *Selaginella selaginoides* in the Great Lakes Region. Asa Gray Bull., n.s., **2:** 287-290.

SOPER, JAMES H. 1954. The Hart's-Tongue Fern in Ontario. Amer. Fern Jour. **44:** 129-147.

———. 1955. *Asplenium cryptolepis* on Manitoulin Island. Amer. Fern Jour. **45:** 97-104.

———., & A. SATHYANARAYANA RAO. 1958. *Isoëtes* in Eastern Canada. Amer. Fern Jour. **48:** 97-102.

DEPARTMENT OF BOTANY, UNIVERSITY OF TORONTO, TORONTO, CANADA.

Chromosome Counts in Some British Columbia Ferns

T. M. C. TAYLOR and FRANK LANG

During the past 15 years pteridologists have been turning increasingly to cytology for help in unravelling taxonomic problems and for better insight into phylogenetic relationships. Manton's (1950) pioneer and classical work charted a course that has proven to be both intellectually stimulating and philosophically rewarding. She and her students have given us a very compre-

hensive picture of the chromosome situation in most European species, and many tropical ones as well.

The pioneering work on chromosome numbers on this continent has been done by Britton (1953) and Wagner (1954, 1955). Thanks largely to their efforts we have a fairly complete knowledge of the chromosome situation in the majority of eastern American species. Comparable data from the Pacific Coast region are, however, almost entirely lacking. The present report is the first of a study planned to remedy this deficiency. It includes only data from British Columbian populations but in course of time others will be added.

MATERIALS AND METHODS

The method used followed the aceto-carmine squash technique method outlined by Manton (1950) with a few modifications. Portions of the fertile fronds were fixed in acetic acid: alcohol for 12-25 hours and then stained in aceto-carmine. The squashes were made with a pair of Bernard pliers with the jaws padded and several pieces of filter paper, cut to proper size, placed between the jaws to absorb excess stain. The squash was made immediately after heating the stain on the slide almost to the boiling point.

Since it was difficult to keep the material in acetic acid: alcohol for any length of time, later collections were fixed in Newcomber's solution and stained in aceto-orcein as suggested by Wagner (1955). This method is more satisfactory.

Most of the cytological material was taken from plants now growing in the greenhouse of the University of British Columbia. Some of the plants are well established cultures several years old while others were brought from the field during the past summer.

All voucher specimens are deposited in the University of British Columbia Herbarium. The numbers are collection numbers of either the senior (T.M.C.T.) or the junior (F.A.L.) author. In most cases clones from which the specimens were taken are growing in the greenhouse. All counts were made by the

junior author and are based on meiotic stages. The results are reported in the table below.

Among these, the writers have failed to find previous reports of chromosome numbers for *Polystichum andersonii*, *P. lemmonii*, *P. munitum*, and *Thelypteris nevadensis*. All are consistent with the generally accepted basic number of the various genera; *Polystichum andersonii* is tetraploid. *Thelypteris nevadensis* appears to be variable, sometimes giving counts of 26 and sometimes 27, which is a matter that should be investigated further. *Thelypteris oreopteris* has not been counted before from North America but agrees with Manton's (1950) results from European material. *Cryptograma crispa* var. *acrostichoides*, also a new report for North America, is diploid and not tetraploid as found to be the case in Europe by Manton (1950). Particular attention has been paid to the variable *Polypodium vulgare* complex; numerous widely distributed populations within the province

TABLE 1.

Taxon	*Voucher*	*n*	*Locality*
Asplenium viride Huds.	FAL 42	36	Moresby Is., Queen Charlotte Islands
Athyrium alpestre (Hoppe) Rylands	FAL 14	40	Mt. Revelstoke
Cryptogramma crispa (L.) R. Br. var. *acrostichoides* (R. Br.) C. B. Clarke	FAL 175	40	Pitt River Mt. Seymour
Dryopteris fragrans (L.) Schott	TMCT 6040	41	Cassiar
Polypodium scouleri Hook. & Grev.	FAL 8	37	Sooke
Polypodium vulgare L. s.l.	FAL 178	37	Mt. Seymour and many other collections
Polystichum andersonii Hopkins	FAL 11	82	Smithers
Polystichum braunii (Spenner) Fée	TMCT 6004	82-84	Gerrard
Polystichum lemmonii Maxon	TMCT 3214	41	Westbridge
Polystichum munitum (Klf.) Presl, f. *imbricans* (Eaton) Clute	TMCT 3217	41	Sooke
Thelypteris nevadensis (D. C. Eaton) Clute	TMCT 3219	26 or 27	Sooke
Thelypteris oreopteris (Ehrh.) Slosson	TMCT 3216	34	Kennedy Lake
Woodsia ilvensis (L.) R. Br.	TMCT 6032	40-41	Telkwa

have proven to be uniformly diploid. In view of our experience the report by Knobloch (1962) of a tetraploid race in Arizona, and of *P. californicum* and *P. hesperium* by Lloyd (1963), is most interesting. It is also of interest to note than *Polypodium virginianum* of eastern North America has tetraploid as well as diploid races (Britton, 1953).

LITERATURE CITED

BRITTON, D. 1953. Chromosome Studies of Ferns. Amer. Jour. Bot. **40:** 575.

KNOBLOCH, I. W. 1962. Tetraploid *Polypodium vulgare* var. *columbianum* from Arizona. Amer. Fern Jour. **52:** 65-68.

LLOYD, ROBERT M. 1963. New Chromosome Numbers in *Polypodium* L. Amer. Fern Jour. **53:**

MANTON, I. 1950. Problems of Cytology and Evolution in the Pteridophyta. Cambridge University Press.

WAGNER, W. H., JR. 1954. Reticulate Evolution in Appalachian Aspleniums. Evolution **8:** 103-118.

———. 1955. Cytotaxonomic Observations on North American Ferns. Rhodora **57:** 219-240.

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Shorter Notes

THE EFFECT OF PHOTOPERIOD ON CERTAIN FERNS.—Several kinds of ferns have been grown in the Hollins College greenhouse for several years for class demonstration purposes. Of a number of species transplanted from nearby localities, three (*Asplenium platyneuron, Woodsia obtusa,* and *Polystichum acrostichoides*) survived; these evidently do not need a period of frost to break fall dormancy. Two other ferns were added, *Adiantum capillus-veneris*, procured from a dealer, and *Pteris vittata*,[1] which appeared as an accidental in pots of other plants that had been purchased. In addition, *Dennstaedtia punctilobula, Osmunda cinnamomea, Athyrium asplenioides*, and *Dryopteris noreboracensis* were collected from a mountain roadside before occurrence of frost.

A set of the greenhouse ferns was placed on the floor where the

[1] Identification by C. V. Morton, of the Smithsonian Institution.

plants received full winter illumination of normal day length and duplicate sets were planted on a bench in a second greenhouse room where artificial illumination by two 75 watt light bulbs were turned on by a time clock at 5 P.M. and off at 11 P.M. These arrangements gave various day lengths as the sun rose earlier, and with the approach of the equinox resulted in day lengths of 15 to 16 hours. Ferns collected from the mountain roadside were placed under the same conditions with a duplicate of each set put outside the greenhouse in gallon tin cans. These were returned to the greenhouse on March 7th and placed under long and short photoperiods.

The plants under the short photoperiod, the natural day length varying from approximately 9 to 12 hours as the equinox was approached, were grown in a room where the thermostat was set to turn on heat at 62° F. The plants under the long photoperiod were in a room with the thermostat set at 68° F. During the day, when sunny, the venting thermostats were set at 75° F., so the temperatures of the two rooms were about the same. The cooler condition for the plants under the short photoperiods did not prevent growth when temperatures slumped, although growth was slower under the cooler conditions. The experiment ended at the equinox, although no substantial change occurred before the last of April.

Pteris proved neutral to day-length, growing and sporulating under both photoperiods. *Adiantum* grew under both photoperiods, but sporulated only under the long day. *Asplenium*, *Woodsia*, and *Dryopteris* showed little or no growth under short photoperiods, but grew under the long photoperiod, although they were sterile, whereas *Polystichum* sporulated abundantly. The others failed to grow under either photoperiod and it is assumed that they need cold to break vegetative dormancy. The duplicates subjected to cold and returned to the greenhouse on March 7th, except for *Dennstaedtia*, also failed to grow. It is presumed that they were destroyed in the unprotected pots during several prolonged cold periods, for they had decayed when examined. The

Dennstaedtia that grew was under the long photoperiod; its copious fronds were sterile.

After the experiment was terminated, it was noted that *Asplenium* and *Woodsia,* growing in another part of the greenhouse, grew and sporulated about the end of April. As days had lengthened to between 13 and 14 hours, it is presumed that these plants responded to an intermediate photoperiod.—PAUL M. PATTERSON AND A. SEWELL FREEMAN, *Hollins College, Hollins College, Virginia.*

SOME NEW YORK CITY NATIVE FERNS.—One of New York City's five boroughs remains a place where a number of native ferns still grow wild. A recent paper[1] reports a total of 24 species of ferns and four fern associates still growing outside of cultivation on Staten Island. The borough retains a number of non-settled areas where some of the commoner ferns are relatively abundant.

The article makes careful comparisons between the authors' finds with those of Dr. Philip Dowell, who made a meticulous survey of Staten Island ferns during the period between 1902 and 1912. Faden and Weingartner's total tally of species is slightly smaller than Dowell's. The latter found 26 ferns, six fern allies, and 10 forms of *Dryopteris* that he considered interspecific hybrids. Three ferns and two fern allies not found by Dowell have been reported from Staten Island between 1912 and 1952. Only one of these, *Lycopodium adpressum,* is known still to grow on the island.

Whereas Dowell found 10 *Dryopteris* hybrids, Faden and Weingartner can record only one, *Dryopteris intermedia* × *spinulosa. Dryopteris clintoniana* and *D. marginalis,* both reported by Dowell, have disappeared.

I had the pleasure of becoming acquainted with some coastal species and several fern hybrids under Dowell's guidance beginning in 1906.—RALPH C. BENEDICT.

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[1] Faden, Robert, and Mathilde Weingartner. 1962. The Ferns of Staten Island. Bull. Torrey Club **89:** 333–335.

Notes and News

An enthusiastic student of ferns living in Australia wishes to correspond and exchange specimens with a resident of the United States. Anyone with a desire to obtain specimens from that part of the world and to participate in exchange of ideas, cultural notes dealing with ferns, etc., should write to Mr. H. Aubrey, Angophora Crescent, Forrestville, Sydney, N. S. W., Australia. Mr. Aubrey has joined the American Fern Society and is listed among the new members in this issue. [I. L. W.]

Members who particiated in the Fern Foray into Mendocino and Humboldt counties, California, in the summer of 1957 will remember Mrs. Ora M. Wilson, her wit, cheerfulness, and enthusiasm. They, and other friends who enjoyed Ora Wilson's courageous and light-hearted approach to life and its problems, will be saddened by word that she passed away on April 26, 1963.

Recent Fern Literature

CYTOLOGY OF SOME INDIAN POLYPODIACEAE.—Some time ago I reviewed a number of papers on the cytology of various Indian fern-allies.[1] A more recent paper[2] contributed data on the chromosome numbers of several members of the Polypodiaceae *sens. strict.* In a few instances Panigrahi and Patniak have found different basic chromosome numbers from those given by Manton[3] in 1955. In *Lepisorus* (J. Smith) Ching, Manton found numbers of $x = 35$, 36, and 37 in three species from Ceylon; Panigrahi and Patniak find $x = 35$ in two species from eastern India,[4] but $x = 13$ for the autotriploid *L. pseudonudus* Ching, and $x = 11$ for a new species, the lowest basic number for a true fern. *Loxogramme* (Blume) Presl, for which Pichi-

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[1]THIS JOURNAL **49:** 39–43. 1959.

[2]Panigrahi, G. and S. N. Patniak. Cytology of Some Genera of Polypodiaceae in Eastern India. Nature **191** (4794): 1207, 1808, *1 fig.* Sept. 16, 1961.

[3]Manton, I., in Holttum. Flora Malaya **2:** 623–627. 1955.

[4]However, only one species, *L. excavatus* (Bory) Ching, is shown in their Table 1.

Sermolli[5] gave a number of $x = 36$ based on a vague assumption made by Manton and Sledge,[6] is here shown to have $x = 35$.

Panigrahi and Patniak adduce some cytological facts in support of recent taxonomic conclusions. The number $n = 36$ for *Drynaria coronans* (Wall. ex Mett.) J. Smith as against $n = 37$ in three other species of *Drynaria* investigated by Manton and Sledge supports Ching's view that this species forms a separate monotypic genus *Pseudodrynaria* Ching. On the other hand, Holttum's view that *Arthromeris* (Moore) J. Smith and *Crypsinus* Presl ought to be merged is not supported by cytological findings, since the three species of *Crypsinus*[7] investigated show numbers of $n = 36$, 35, and 33 whereas *Arthromeris wallichiana* (Spreng.) Ching has $n = 37$. The basic numbers for *Pyrrosia* Mirbel ($n = 36$) and *Microsorium* Link ($n = 36$) given by Manton and Sledge are verified by Panigrahi and Patniak. These authors have established for the first time the basic numbers of *Arthromeris*, *Colysis*, *Loxogramme*, and *Pseudodrynaria*.

The following table gives their results:

Arthromeris wallichiana (Spreng.) Ching	$n = 37$ [diploid]
Colysis elliptica (Thunb.) Ching var. *pothifolia* (D. Don) Ching	$n = 36$ [diploid]
Crypsinus crenato-pinnatus (Clarke) Copel.	$n = 36$ [diploid]
Crypsinus oxylobus (Kunze) Sledge	$n = 35$ [diploid]
Lepisorus excavatus (Bory) Ching	$n = 35$ [diploid]
Loxogramme avenia (Blume) Presl	$n = 35$ [diploid]
Loxogramme involuta (D. Don) Presl	$n = 70$ [tetraploid]
Loxogramme lanceolata (Swartz) Presl	$n = 35$ [diploid]
Loxogramme scolopendrina (Bory) Presl	$n = 35$ [diploid]
Microsorium membranaceum (D. Don) Ching	$n = 36$ [diploid]
Microsorium pteropus (Blume) Copel.	$n = 36$ [diploid]
Microsorium superficiale (Blume) Ching	$n = 36$ [diploid]
Pseudodrynaria coronans (Wall. ex Mett.) Ching	$n = 36$ [diploid]
Pyrrosia flocculosa (D. Don) Ching	$n = 36$ [diploid]
Pyrrosia mannii (Giesenh.) Ching	$n = 37$ [diploid]

[5]Vistas in Botany 479. 1959.
[6]Phil. Trans. Roy. Soc. London, ser. B, **238:** 171. 1954.
[7]However, only two species of *Crypsinus* are listed in Table 1.

Pyrrosia subfurfuracea (Hook.) Ching	$n = 37$ [diploid]
Lepisorus pseudonudus Ching	$2n = 39$ [autotriploid]
Lepisorus sp. nov. (Jowai)	$n = 22$ [diploid]

It is a pity that a communication of this nature, of importance to fern taxonomy, was inserted in a periodical of purely general interest. It would have been better to publish such a paper in one of the specialized periodicals dealing with ferns and fern-allies. Doing so might also have guaranteed better reproduction of the photographs illustrating the cytological finds and also more accurate editing of the scientific names and author citations.—HANS PETER FUCHS, *Wassenaar* [*ZH*], *The Netherlands.*

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1. Authors of papers submitted to the *American Fern Journal* should consult the *Style Manual for Biological Journals* (1960) and be guided by its examples.

2. The "name-and-year" system for bibliographic references will, except in exceptional cases, be used. (See Literature Cited below for an example).

3. Authors are encouraged to use the journal abbreviations set forth by Schwarten and Rickett (1958, 1961).

4. Abbreviations of names of herbaria will be those listed by Lanjouw and Stafleu (1959).

5. Reports of chromosome numbers will not be accepted unless documented.

6. The use of footnotes and tabular matter should be kept to a minimum.

7. All manuscripts submitted for publication should be typed, double-spaced, and have ample margins.

8. Reprints should be ordered when galley proof is returned to the Editor. An order blank will be included with the galley proof.

Literature Cited

American Institute of Biological Sciences, Committee on Form and Style of the Conference of Biological Editors. 1960. Style Manual for Biological Journals. American Institute of Biological Sciences. Washington, D. C. 100 p.

Lanjouw, J., and F. A. Stafleu. 1959. The Herbaria of the World. Index Herbariorum, Regnum Veg. **15**: 1-249.

Schwarten, L., and H. W. Ricket. 1958. Abbreviations of Titles of Serials Cited by Botanists. Bull. Torrey Club **85**: 277-300; 1961. Supplement I. Ibid. **88**: 1-10.

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JOHN H. THOMAS

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American Fern Journal

VOL. 53 OCTOBER-DECEMBER, 1963 No. 4

New or Noteworthy Ferns from the Tonga Islands

KUNIO IWATSUKI

Mr. M. Hotta made a collecting trip on the Islands of Tonga in southwestern Polynesia from July to October, 1960, as botanist of the Tonga Expedition 1960 of Kyoto University. He brought to our institute a large number of fine plant specimens and offered the pteridophytes to the writer for identification.

The flora of the Tonga Islands was recently revised by Professor T. G. Yuncker[1] based chiefly on his own collections, the pteridophytes of which were determined by C. V. Morton and the late A. H. G. Alston. We have, however, additional and noteworthy species detected in the Hotta collection, which included 62 species of ferns and their allies. A complete list of his collection will be presented in the near future in a separate publication, and the writer will summarize here the new or noteworthy records only.

The writer is greatly indebted to Mr. M. Hotta for making the collections available.

1. CREPIDOMANES HUMILE (Forst.) Copel., Phil. Journ. Sci. **67**: 58. 1938.

'Eua: east of Pangai, *Hotta 5304*. Tofua: outside of somma at the east of the island, *Hotta 4347*. New to Tonga, hitherto known from Sumatra to Tahiti.

2. CEPHALOMANES BORYANUM (Kunze) van den Bosch, Ned. Kr. Arch. **4**: 351. 1859; Copel., Phil. Journ. Sci. **67**: 68. 1938.

Tofua: eastern part of the island, *Hotta 4348*. New to Tonga, previously known from Micronesia and Polynesia.

3. THELYPTERIS HARVEYI (Mett. ex Kuhn) Proctor. – *Aspidium harveyi* Mett. ex Kuhn, Linnaea **36**: 115. 1869. – *Nephrodium harveyi* (Mett. ex Kuhn) Baker; Hemsley, Proc. Linn. Soc. **30**: 202. 1895; Burkill, Proc.

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[1]Yuncker, T. G. Plants of Tonga. Bull. B. P. Bishop Mus. No. 220. 1959. Volume 53, No. 3, of the JOURNAL, pp. 93-132, was issued September 27, 1963.



Linn. Soc. **35**: 65. 1901. – *Dryopteris euaensis* Copel., Univ. Calif. Pub. Bot. **12**: 391. 1931, type from Tonga; Yunck., Bull. B. P. Bishop Mus. **220**: 23. 1959. – *Lastrea euaensis* Copel., Gen. Fil. 138. 1947.

'Eua: 'Ohonua Village, *Hotta 5182;* east of Pangai Village, *Hotta 5326;* south of Esi-o-mohe'ofo, near Tao'o Mani, *Hotta 5563.* Tofua: southern part of the island, *Hotta 4911.* Widely distributed in Polynesia.

Copeland distinguished *Dryopteris euaensis* from *D. harveyi* by the fact that the lower pinnae dwindle very gradually and become increasingly remote, even the lowest being well developed and deeply pinnatifid. *Thelypteris harveyi* is known widely from Polynesia and varies to a certain degree in every characteristic. The feature seen in the lower pinnae is, therefore, not restricted to the Tongan plant, and no feature sufficiently discriminative can be found on the Tongan plants.

4. THELYPTERIS ULIGINOSA (Kunze) Ching, Bull. Fan Mem. Inst. Biol. **6**: 342. 1936.

'Eua: 'Ohonua Village, *Hotta 5183, 5184.* Tofua: southeastern part of the island, *Hotta 4339, 4340.* New to the Tonga Islands, previously known widely in Palaeotropics, from India to Japan and south to Polynesia and Australia.

5. THELYPTERIS LEUCOLEPIS (Pr.) Ching, Bull. Fan Mem. Inst. Biol. **6**: 345. 1936.

Tofua: southern part of the island, *Hotta 4316, 4317.* Late: western side of mountain, *Hotta 4794, 4798.* New to Tonga, previously known from Malaysia and Polynesia.

6. CYCLOSORUS GONGYLODES (Schukuhr) Link, Hort. Berol. **2**: 128. 1833.

Tongatapu: west of Nuku'alofa, *Hotta 4499, 4501;* Havelu-loto Village, south of Nuku'alofa, *Hotta 5103.* Vava'u: at the summit of Mounga-lafa, Longomapu Village, *Hotta 5048.* New to Tonga, previously known from the tropics of both New and Old Worlds.

7. **Cyclosorus orthocaulis** K. Iwatsuki, *sp. nov.* Plate 9.

Caudice erecto, apice dense et stipitibus sparsius paleis fuscis obtecto; lamina ca. 50 cm longa, 7-9 cm lata, apice pinnatifida, ad basin sensim vel subabrupte contracta, pinnis infimis remotis ad vestigia vix manifesta reductis, pinnis medialibus alternantibus, acutis, basi truncatis, ca. ½ viae ad costam incisis, lamina setulosis; venulis 5- vel 6-jugis, quarum 1-paribus anasto-

PLATE 9. PHOTOGRAPH OF TYPE SPECIMEN OF CYCLOSORUS ORTHOCAULIS IWATSUKI, DEPOSITED IN HERBARIUM OF KYOTO UNIVERSITY

mosantibus; soris medialibus, indusiis persisentibus stulosis.

Caudex erect, 6 mm. in diameter except the appressed basal remains of stipes, the apex densely covered with the scales: stipes fascicled, very short, stramineous, pubescent, the base very sparsely scaly. Fronds narrowly lanceolate, acuminate at the apex, gradually narrowing downward, bearing reduced butterfly-like pinnae almost to base of stipes, up to 40 cm. long (except the portion with the pinnae extremely reduced), 7-10 cm. wide; rachis like upper parts of stipe, grooved on the upper surface, stramineous, densely pubescent and glandular throughout; pinnae numerous, the medial ones alternate, patent or oblique, linear lanceolate, acute to acuminate at the apex, broadest at the truncate sessile base, 3.5-5.0 cm long, 0.7-1.0 cm wide, cut half way down to the costa into oblong, oblique lobes with round or obtuse apices, the lower pinnae gradually reduced into scale-like lobed pinnae; costae almost straight, or slightly curved upwards in the upper, densely pubescent and setose pinnae, slightly grooved on the upper surface; ultimate segments 2.0-2.5 mm broad, almost entire, separated by fairly broad sinuses; texture herbaceous or very coarse papyraceous, densely minutely pubescent on both surfaces, with yellowish, round glands rather dense on laminar surfaces and every axis. Veins pinnate, with 5-6 pairs of veinlets, bearing setose hairs and minute soft ones, the basal veinlet united with that of next group with an excurrent veinlet at the junction, the basal second anterior veinlet connivent with the excurrent veinlet at the setose hyaline membrane at the base of the sinus, other veinlets all running to the free margin above the sinus membrane. Sori medial, dorsal on veinlets, usually absent on the upper 2-3 pairs of veinlets, indusiate; indusia reniform, persistent, rather large, membranous, hirsute; sporangia rather large, glandular, annulus with 16-20 thickened cells; spores bilateral, brownish, tuberculate on the surface, with perispore. Scales only on the rhizome and on the very base of stipes, linear, 3-5 mm long, 0.5 mm broad, bright brown with paler margin, membranous, densely hirsute on the

margin; setose hairs on every axis, up to 1.5 mm long, whitish, the minute soft hairs less than 0.3 mm long, unicellular, rather dense on every part of plant; yellow glands present everywhere on the fronds, globular, sessile, less than 70 μ in diameter.

Tonga. Type in the herbarium of Kyoto University: Isl. 'Eua: Mt. Tapatapa'ao, east of Pangai Village, in dense forest, *Hotta 5243*.

The present new species seems most closely allied to *Cyclosorus protectus* (Copel.) Copel., Gen. Fil. 143. 1947. (cf. Copeland, Phil. Journ. Sci. **77**:453. *pl.* **33**. 1949) of New Guinea. From that species the present species differs in its smaller size, the pinnatifid pinnae with broadly cuneate base, and the hairy and glandular laminae. The veinlets of this species are in 5-6 pairs, the basal pair angularly join each other, and give rise to a free excurrent veinlet from their junction; the anterior second basal veinlet is connivent to the callous sinus, and the other veinlets run to the free margin of the lobes. This species resembles also *C. nymphalis* (Forst.) Ching (Bull. Fan Mem. Inst. Biol. **10**:247. 1941), but is readily distinguishable by the gradually reduced lower pinnae, alternate herbaceous pinnae with a broad truncate base, hairy and yellow-glandular under surface and by the difference in venation.

8. CYCLOSORUS EXTENSUS (Bl.) H. Ito, Bot. Mag. Tokyo **51**: 713. 1937.

Vava'u: summit of Mounga-lafa, Longomapu Village, western end of the island, *Hotta 5046, 5048*. New to Tonga, previously known from continental Southeastern Asia and Malaysia.

9. CYCLOSORUS DENTATUS (Forsk.) Ching, Bull. Fan Mem. Inst. Biol. **8**: 206. 1938.

Tongatapu: near Havelu-loto Village, south of Nuku'alofa, *Hotta 5058*. Vava'u: northwest of Leimatua Village, *Hotta 4605*. New to Tonga, known throughout the tropics.

10. CHEILANTHES TENUIFOLIA (Burm.) Sw., Syn. Fil. 129, 332. 1806.

Late: northwestern part of the island, *Hotta 4443;* west of the island, *Hotta 4451*. Australia and Polynesia through Malaysia to India and South China.

11. PITYROGRAMMA BRACKENRIDGEI (Carr. ex Seem.) Maxon, Dept. Mar. Biol. Carn. Inst. **20**: 124. 1924.

Tofua: southeastern part of the island, *Hotta 4305;* southern part of the island, *Hotta 4902;* near the top of somma, *Hotta 4382*.

Tofua is the second locality of this Samoan species. This is, again, the second record for this American genus from Polynesia. It is interesting that the range of *Pityrogramma* is now extended far west to the present islands. The plants were collected on rather dry igneous rocks in open places. It is improbable that the plant has naturalized from cultivation.

12. PTERIDIUM AQUILINUM var. ESCULENTUM (Forst.) Kuhn, Chaetopt. 347. 1882.

Tofua: northern part of the island, *Hotta 4415*. New to the Tonga Islands, known commonly in the Polynesian regions.

13. ELAPHOGLOSSUM sp.

Tofua: eastern part of the island, *Hotta 4346*. This is the only collection of the genus from the island, but further identification is impossible, as the specimen is sterile. This is the first record of *Elaphoglossum* from the Tonga Islands.

14. BLECHNUM VULCANICUM (Bl.) Kuhn, Ann. Mus. Lugd. Bat. **4**: 284. 1869.

Late: top of dormant volcano, *Hotta 4789*. This species is widely distributed in Polynesia and Australia.

DEPARTMENT OF BOTANY, KYOTO UNIVERSITY, KYOTO, JAPAN.

First Fern Records from Virginia: John Banister's Account of 1679-1692[1]

JOSEPH EWAN

Seventy-four years *before* the *Species plantarum* of Linnaeus appeared, John Banister (1654-1692) listed seventeen ferns and lycosphens from Virginia. It is natural to think that our fern binomials originated with the Great Swede when, in fact, many of the common Atlantic Coast forms were known quite precisely under earlier polynomial names to naturalists, some of whom, like Banister, died before Linnaeus was born. Like Clayton's discoveries in Virginia in the next century, Banister's pioneer observations and descriptions of ferns and flowering plants would be quite unknown had not other botanists interested themselves in his work. Gronovius published Clayton's findings; John Ray (1686-1704) and Leonard Plukenet (1691-1705), Banister's.

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[1]Presented at the American Fern Society meeting, Stillwater, Oklahoma, 1960. Research supported by National Science Foundation, 1959-60.

Only Banister's early Catalogue was published, and his more complete account, edited by Sherard, rested in manuscript nearly three hundred years before its significance was understood.

This report describes only a small segment of a five-part manuscript recently brought to light at Oxford which is being edited for publication by Mrs. Ewan and me, including the identification of the approximately 375 plant species. In addition to the plant catalogue, the largest of five parts, the manuscript contains an account of insects, one of molluses, another of general natural history, and an account of the Indians. In short, Banister's is the first *scientific* account for Virginia in the field of descriptive botany, entomology, and malacology. John Banister had keen powers of observation, a talent for drawing—he was self-taught—and familiarity with contemporary literature based upon an Oxford education in botany and natural philosophy. Had Banister lived beyond his thirty-eight years—he was accidently shot by a companion while on a field trip—he would certainly have profoundly altered the course of science in colonial America.

Reverend Banister arrived in Virginia about the year 1676, and evidently began at once observing, collecting, and describing in Latin phrases the plants, including the ferns, he found there. His nominal task was as clergyman to the Church of England; his frontier work was among the colonists, and perhaps among the Indians, and in the world of nature that surrounded him. In the remarkably short span of about three years he assembled a catalogue of the plants he had found, noting their relationships with European species, or suggesting possible alliances if the plants were wholly new to him. Made acutely aware of the value of preparing a graphic record, he then taught himself to draw, and fifty-three of his sixty-five drawings survive in the British Museum, the majority published, sometimes modified, and with or without acknowledgment of their source, by Plukenet (1691-1705) whose *Phytographia* was extensively used by Linnaeus in his works on American botany.

Banister wrote detailed letters on Virginia natural history



Right: Plukenet's figure of Walking Fern based on Banister's drawing Published in his Phytographia and captioned "Phyllitis parva saxatilis per summitates foliorum radicosa Banist [er] Cat [alogus] Stirp [ium] Virg [ininse] . . ."

Left: Banister's original (unpublished) drawing of Walking Fern made in Virginia preserved in the British Museum (published by courtesy of the Trustees).

[The "*" just above the growing point of the plantlet relates to a matching "*" barely discernible at the tip of the upper frond. The handwriting is not Banister's, possibly Plukenet's, in spite of change of "prolifera" to "radicosa" in published version.]

to his British colleagues, Dr. Robert Morison and Bishop Compton, to John Ray, Dr. Martin Lister, and perhaps to James Petiver. Four of Banister's letters, besides the excerpts which Lister published in *Philosophical Transactions* (1693), have been traced.

We know from William Aiton's printed record of the introduction dates of American plants into English horticulture that Banister certainly sent more novelties to his homeland than any other visitor to the New World before the year 1700. In Aiton's *Hortus Kewensis* many of Banister's introductions were listed with credit to him, although more usually they were credited to Bishop Compton and Jacob Bobart, both of whom enthusiastically grew his seeds and plants from Virginia.

It is of interest and is acknowledged that this study could have made little progress if it had been undertaken before the completion of the recent works of Raven (1942) on the life and times of John Ray, of Dandy (1958) on the content of the Sloane Herbarium, of Vines and Druce on the Morisonian Herbarium (1914), and of Raymond Phineas Stearns (1953) on the contribution of James Petiver. The several librarians who have enabled us to locate and identify three different manuscript versions of Banister's Virginia natural history, first at Oxford, then the British Museum, and recently at Colonial Williamsburg, have been most helpful.

We shall not repeat here Banister's Latin for the seventeen Pteridophyta he described from Virginia; it will be published with the detailed account, but what he found and recorded are summarized here. His description of what we today call *Botrychium virginianum* was the partial basis of Linnaeus's *Osmunda virginiana*, and Banister's description and drawing of the walking fern were mentioned by Morison, Plukenet, and Petiver, and all contributed to Linnaeus's establishing the species *Asplenium rhizophyllum*, later called *Camptosorus*. Linnaeus specifically cited Virginia as the source of seventeen Pteridophyta, and Banister knew thirteen of these. In short, Banister knew the majority

of the Virginia ferns and lycosphens described by Linnaeus seventy-four years later, a not inconsiderable and little appreciated fact. The four cited by Linnaeus, but not described by Banister, are *Osmunda claytoniana*, commemorating its discoverer, John Clayton, *Pellaca atropurpurea*, and *Woodwardia areolata*. *Polystichum lonchitis*, noticed for Virginia by Linnaeus, must have been mistakenly associated with that colony at the time *Species plantarum* was written. Some of Banister's one-line descriptions refer to classic works by Parkinson whose reference to *Adiantum pedatum*, for example, is the basis of Banister's admitting a Virginia fern to that species; or to Gerard whose good illustration of *Botrychium virginianum* contributed to Banister's recognition of the grape fern; or to Matthiolus, or Dodonaeus—each author in fact resting his work, then as now, on the labors of others.

Incidentally, the eighteenth century of Linnaeus muddled the knowledge of Virginia ferns, and the inimitable Professor Fernald (1935) detailed the story of *Asplenium platyneuron* in this connection. Three ferns were curiously mixed by Linnaeus, and only by adopting as a clear basis the collection made by Clayton and described by Gronovius are we able to salvage the name. Had Banister's original description and drawing been published during his lifetime subsequent confusion in this and other fern typifications would have been averted.

The Reverend botanist was so fascinated by the walking fern that he wrote one of his longest surviving accounts for any Virginia species, relating its growth and habitat. Fortunately William Sherard copied this from a letter into his draft of Banister's *Catalogus* at Oxford; this detailed account of the walking fern is lacking in the *Catalogus* in Banister's own hand preserved at the British Museum (cf. Ewan, in press).

"Phyllitis parva saxatilis per summitates foliorum prolifera. In Sept. last we occasionally took a journey towards, I might have said, to the mountains, had not the Indians wch were our guides, been afraid as they pretended, but I am apt to think it was policy not fear retarded them, and that they were unwilling

to let us be acquainted with their recesses so far up in the country. In our march about 35 miles above the Falls of the James River on the southside our small path brought us to a vast rock, or rather the side of a hill, wch seem'd to be of entire stone part of wch was very thinly spread over with a swift fall of water, wch made a pleasant not loud noise, having no cragginess to interrupt its course. A little lower down this rivulet is received into a natural bason, & from thence conveighed into a small vault of craggy rocks, where with its fall it makes a Hollow sound, something like that of a kettle drum, but more like an Indian one, wch is a skin stretched over an earthen pot half full of water; it just shews its self & is again rec'd into an open Arch of rough stone, where among other Capillaries[2] grows this small but rare kind of Harts-tongue. This plant grows erect as others of the like kind, till it comes to the age of puberty and nature calls it down to propagate, & w^n^ its offsetts are strong enough to draw their own aliment it leaves them & grows up as before. This rock is crowned with not very large but well spreading trees of cypress-leav'd Savin under whose shade on beds of matted moss, we eat our dinner, & wis'd we might meet wth a place as pleasant & commodius four our repose at night. We went a day's journey & a half further & then cross'd the river wch we found prettie wide, but by reason of its declivity in many places fordable. In our way home the rich low grounds abounded with a kind of wild Baulm wch being trampled on by our horses as we rode thro it mightily refreshed us with its fragrant scent. Little else I think occur'd on this or the other side worth giving an acc(oun)tt of."

From this quotation you will see that Reverend John Banister had a genuine love of the Virginia woods and rivers, and wrote charmingly of her natural history.

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[2] Banister alludes to Maidenhair which included species both of *Adiantum* and *Asplenium*, and from which the medicinal *Syrup of Capillary* was made. *Cf*. R. C. Benedict (1957).

Any botanist who has an interest in the history of his science can hardly avoid wondering about the possible existence of other manuscripts and notebooks that may be hidden in seldom-opened storage files. Some of them, if made available and studied carefully, almost surely would provide helpful information about early exploration routes, dates, and field observations. They might hold keys to some of the riddles surrounding the application of names given to plants by early writers, but not associated clearly, with any existing specimen.–Ed.

VIRGINIA FERNS AND FERN ALLIES KNOWN TO BANISTER (1679-1692)

Lycopodium alopecuroides L.
***Selaginella apoda* (L.) Spring**
Selaginella rupestris (L.) Spring
Botrychium virginianum (L.) Sw.
Osmunda regalis L.
Woodsia ilvensis (L.) R. Br.
Cystopteris fragilis (L.) Bernh.
***Onoclea sensibilis* L.**
Thelypteris phegopteris (L.) Slosson
Polystichum acrostichoides (Michx.) Schott
Camptosorus rhizophyllus (L.) Link
Asplenium platyneuron (L.) Oakes
Woodwardia virginica (L.) Sm.
Adiantum pedatum L.
Adiantum capillus-veneris L.
Polypodium virginianum L.
Polypodium polypodioides (L.) Watt

LITERATURE CITED

BENEDICT, R. C. 1957. Maidenhair as a source of medicine. Amer. Fern Jour. **47:** 110-111.

DANDY, J. E. 1958. The Sloane Herbarium. British Museum, London.

EWAN, J. and N. EWAN. In press. John Banister and his Natural History of Virginia, 1679-1692. Univ. Wisconsin Press, Madison.

FERNALD, M. L. 1935. Midsummer vascular plants of Southeastern Virginia. Rhodora **37:** 378-454, (See pp. 382-384).

LISTER, MARTIN. 1693. Extracts of four letters from Reverend John Banister. Phil. Trans. **17:** 667-672.

PLUKENET, LEONARD. 1691-1705. Phytographia. London.

RAVEN, CHARLES E. 1942. John Ray, naturalist, his life and works. University Press, Cambridge.

RAY, JOHN. 1686-1704. Historia plantarum. 3 vols. London. (Banister's Catalogus, in somewhat shortened form, in vol. 2, pp. [1926]-1928.)

STEARNS, RAYMOND P. 1953. James Petiver, promoter of natural Science. Proc. Amer. Antiq. Soc. **42:** 243-365.

VINES, S. H., & G. C. DRUCE. 1914. An account of the Morisonian Herbarium in the possession of the University of Oxford. Clarendon Press, Oxford.

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Low Percentage and Grade of Euploidy in the Family Polypodiaceae in Relation to the Epiphytic Habit—An Hypothesis

G. PANIGRAHI AND S. N. PATNAIK

The Polypodiaceae (sensu Copeland, 1947) is predominantly an epiphytic family of ferns of tropical and subtropical evergreen forests. Most members of the family grow with short or extensive creeping rhizomes on moss-covered tree trunks or on humus-covered rocks and boulders. Perusal of papers dealing with the chromosome numbers of 85 species belonging to 22 genera investigated up to the present time (see Manton, 1950; Holttum 1954; Manton & Sledge, 1954; Mehra, 1961a; Nayar, 1958; Bir, 1906; Panigrahi, 1962; Panigrahi & Patnaik, 1961; 1962; and Patnaik & Panigrahi, 1963) reveals the following broad features about the cytological picture of the family.

1. The basic chromosome numbers in the family range from $x=11$ to $x=47$, of which $x=36$ and $x=37$ are more frequently prevalent, characterizing 14 and eight genera, respectively.

2. Five genera, viz., *Drynaria*, *Pleopeltis* (=*Lepisorus*), *Polypodium*, *Goniophlebium* and *Pyrrosia*, are characterized by both $x=36$ and $x=37$, whereas only *Pleopeltis* (=*Lepisorus*) reveals an astonishing array of haploid and diploid chromosome numbers, namely, $n=22$, 23, 35, 36, 47, 74, and $2n=39$ in different species.

3. All but 14 species investigated so far are diploids showing regular bivalents at meiosis, with the rare exception of *Lepisorus pseudonudus* Ching, with $2n=39$ and characterized by irregular meiosis.

4. Of the 14 euploid cytological types, only four taxa are hexaploids, the remaining ones having attained only tetraploid levels. This reveals both a low percentage (17%) and a low grade of euploidy, in sharp contrast with the cytological picture presented by families like the Aspidiaceae with 39%, Pteridaceae with 44%, Aspleniaceae with 80%, Blechnaceae with 56%, and Vittariaceae with 89% of euploidy, although the epiphytic family

Davalliaceae with 11% of euploidy closely resembles the Polypodiaceae.

Contrary to expectations, it appears that euploidy has played an insignificant role during the recent past in the evolutionary history of the Polypodiaceae. Manton (1953, 1954), from her findings of higher percentages and higher grades of euploidy in the fern flora of Ceylon and Malaya, in contrast to the lower percentage and lower grades of euploidy in the subtropical Madeira and the temperate British Isles, postulated that the rate of evolution is much faster in the tropics than in more temperate latitudes. This hypothesis was supported by Mehra (1961b) on the basis of his cytological studies of the fern flora of the eastern and western Himalayas. While Manton (1954) attributed this phenomenon to the potentiality of polyploids for inhabiting new ecological niches provided by the greater wealth of habitats in a more closely populated and stratified vegetation in the tropical and subtropical forests, Mehra (1961b) believes the greater percentage of polyploids arising from interspecific hybridization in the tropical and subtropical forest floors is conducive to prothallial development.

What does explain the low percentage and low grade of euploidy in the family Polypodiaceae, the members of which are mostly restricted to the tropical and subtropical forests? We believe this is somehow inter-related with the general epiphytic habit of the family. Most of the species grow perched on tree trunks and branches in the middle strata, high above the forest floor, inside a closed forest canopy. This habitat limits dissemination of spores by wind over appreciable distances, even inside the forest. The spores of a particular species may be washed to the forest floor by rain water, but it may be extremely difficult for the spores to germinate on the leaf-littered forest floor. If, however, germination takes place in micro-ecological niches and functional prothalli are formed, the chances of interspecific hybridization with prothalli of genetically related species in the neighborhood must be considered extremely meager. Such

chance crossing with related prothalli, if it occurs, could produce a sterile F_1 hybrid which might fail to establish a hybrid clone because of insufficient light and too much moisture on the leaf-littered forest floor. This uniform habitat on a closed forest floor not subjected to the violent changes of the type postulated by Manton, perhaps would prevent doubling of chromosome complements in the F_1 sterile hybrid, and without such doubling the hybrid could not overcome the handicap of sterility and would not become established so successfully as the diploid parents perched high on the tree trunks.

The haploids which germinate from spores in the crevices of the bark on tree trunks may not get an opportunity for cross fertilization with similar prothalli of related species, as the periodicity of antheridial and archegonial maturity and the quantity and direction of flow of rain water at the appropriate moment may be limiting factors in such situations. Thus, the epiphytic habit inside a closed canopy of the tropical and sub-tropical forests may explain the low percentage and low grades of euploidy in the family Polypodiaceae.

Similar cytological pictures of low percentages and low grades of euploidy are presented by another epiphytic family, the Orchidaceae, among the Angiosperms, and in the Davalliaceae among the ferns, growing sympatrically in closely similar conditions. Discovery of 89% of euploidy in the Vittariaceae, another epiphytic family of the tropical forest may be due to the statistically low number of its species investigated cytologically, whereas similar features in the Aspleniaceae may arise owing to the occurrence of the genus *Asplenium* in many diverse habitats throughout the world, which is not, therefore, closely comparable with the predominantly epiphytic family Polypodiaceae.

Discovery of euploidy in the most primitive and the only known wholly terrestrial genus of the mainly epiphytic family Polypodiaceae, *Dipteris* [viz., *D. conjugata,* with n=ca. 33, in Malaya (Manton in Holttum, 1954) and *D. wallichii,* with n=66, in Assam (Panigrahi, 1962)], lends support to the hypothesis:

"The epiphytic habit in closed tropical and subtropical forests works as a 'bottleneck' to the induction of euploidy, whereas the terrestrial habit in the identical situations is highly conducive to the induction of euploidy."

Our grateful thanks are extended to the authorities of the Council of Scientific and Industrial Research, New Delhi, for financial asistance, including an award of a Junior Research Fellowship to the junior author, for carrying out cytotaxonomic studies on East Indian Polypodiaceae; and to the Director, Botanical Survey of India, Calcutta, for encouragement during the progress of our research.

LITERATURE CITED

BIR, S. S. 1960. Cytology of some "Acrostichoid" Ferns. Nucleus **3:** 121-124.

COPELAND, E. B. 1947. Genera Filicum. Waltham, Mass.

HOLTTUM, R. E. 1954. A Revised Flora of Malaya. Vol. II. The Ferns of Malaya. Government Printing Office, Singapore.

MANTON, I. 1950. Problems of Cytology and Evolution in the Pteridophyta. University Press, Cambridge.

———. 1953. The cytological evolution of the fern flora of Ceylon. Symposia of Society for Experimental Biology No. 7, Evolution. 174-185.

———., & W. A. SLEDGE. 1954. Observations on the cytology and taxonomy of the pteridophyte flora of Ceylon. Phil. Trans. Roy. Soc. ser. B, **238:** 127-185.

MEHRA, P. N. 1961a. Chromosome numbers in Himalayan ferns. Res. Bull. Punjab Univ. **12:** 139-164.

———. 1961b. Cytological evolution of ferns with particular reference to Himalayan forms. Proc. 48th Ind. Sci. Cong. Assoc. Pt. II. Sect. Botany: 130-153.

NAYAR, B. K. 1958. Studies in Polypodiaceae—V. Cytology of *Colysis pedunculata* (Hk. et Grev.) Ching. Sci. & Cult. **27:** 499-501.

PANIGRAHI, G. 1962. Cytology and i.s contribution to fern systematics. Proc. Summer School of Botany, New Delhi. 261-275.

———., & S. N. PATNAIK. 1961. Cytology of some genera of Polypodiaceae in eastern India. Nature **191:** 1207-1208.

———. 1962. Cytotaxonomic studies on *Aglaomorpha coronans* (Wall.) Copel. Bull. Nat. Inst. Sci. India **19:** 54-58.

PATNAIK, S., & G. PANIGRAHI. 1963. Cytology of some genera of Polypodiaceae in eastern India—II. Amer. Fern Jour. **53:** 40-46.

BOTANICAL SURVEY OF INDIA, ALLAHABAD, INDIA.

The Classification of Thelypteris

C. V. MORTON

In a paper discussing some ferns of the eastern United States that I published in 1950 (Morton, 1950) I proposed to recognize a large inclusive genus *Thelypteris* Schmidel, including as sections or subgenera *Lastrea*, *Cyclosorus*, *Steiropteris*, *Glaphyropteris*, *Goniopteris*, *Meniscium* and others. In this I was followed by Proctor in his preliminary study of Jamaican ferns.

With most questions dealing with the delimitation of genera the answers are purely subjective and depend at least in part on the training and temperament of the investigator. Some workers, particularly E. B. Copeland, believe that small genera are more "convenient," by-passing the question of "convenient for whom?" When genera are split as finely as those of Copeland and Ching they can be recognized easily only by professional pteridologists (and not always by them with certainty!). Although it may well be that the small genus is theoretically desirable, it can hardly be disputed that a larger genus that can be recognized in the field and in the herbarium by the general botanist (and in many cases by numerous amateur botanists as well) is more practical and desirable, especially when non-systematists are considered. The results obtained by ecologists, physiologists, phytogeographers, and others are more meaningful when the relationships between the species are not obscured by referring them to different genera.

The considerations mentioned above will not apply when the large genus is not a consistent and relatively homogeneous entity. A good example of a homogeneous large genus is *Asplenium*, with about 700 species; some authors with splitting tendencies have regretted that the genus has thus far "resisted" attempts to split it, but others can be grateful. The same can be said of *Elaphoglossum*, with about 500 species. In my opinion, *Thelypteris* in the broad sense is such a genus, more diverse naturally than *Elaphoglossum* and *Asplenium* because of the larger number of species (perhaps 900) and the greater com-

plexity of the blades in general. Nevertheless, there is a close relationship apparent among all the species and a general facies that allows easy recognition of the genus both in the field and the herbarium, when the characters are known. The general union with *Dryopteris* in the past has tended to obscure the special characters of *Thelypteris*.

Some of the characters of *Thelypteris* as opposed to *Dryopteris* may be briefly recapitulated: Acicular, one-celled hairs present on the costae above (no hairs in *Dryopteris*); costae above not grooved or if so the margins of the groove not decurrent on the next lower rhachis (costae grooved above with the margins of the groove decurrent on the next lower rhachises in *Dryopteris*); veins mostly simple (very rarely forked), free and reaching the margin above the sinus or running to the sinus or in species with broader wings along the costae uniting by pairs within the leaf tissue and sending forth an excurrent vein or in unlobed species all the veins uniting within the leaf tissue and connected by the excurrent veinlets, i.e. venation "meniscioid" (veins free and forked, not reaching the margin, with hydathodes at apex in *Dryopteris*); spores usually smoothish or echinate (usually cristate in *Dryopteris*); segments (and often rhizome scales) usually ciliate (segments and scales not ciliate, although the latter often with marginal fibrils, in *Dryopteris*); blades thin-membranaceous to herbaceous and often with dull surfaces (blades subcoriaceous and shining in *Dryopteris*); stipe bundles two and uniting below the base of the blade, so far as known (stipe bundles three or more and free in *Dryopteris*); sporangia sometimes setose (sporangia glabrous in *Dryopteris*); indusia often small, often hairy (indusia usually large and vaulted, glabrous, sometimes stipitate-glandular in *Dryopteris*); rhizomes often creeping, sometimes erect but then relatively slender (rhizomes usually erect and massive in *Dryopteris*); basic chromosome number uncertain but perhaps $n = 36$ (and 35?), although few species have been investigated ($n = 41$ in *Dryopteris*).

As indicated above, the species of *Thelypteris* all have a num-

ber of fundamental and distinctive characters in common. The same can not be said for the various segregates recognized by Copeland and others: They are "one character" genera, if such a thing can be conceived. Theoretically, true genera differ not in just one respect but in all parts of the plant (or animal)—in roots, stems, leaves, reproduction, histology, cytology, physiology, and ecology. But such a genus as "*Goniopteris*" in the sense of Copeland differs from *Cyclosorus* in no way but in having stellate or branched hairs, and *Cyclosorus* from *Lastrea* only in having united not free veins, and even these differences are illusory. In most species the stellate hairs are accompanied by typical unicellular hairs of the *Thelypteris* type. Two species (*Dryopteris macrotis* and *D. subhastata*) referred by Christensen, who knew these plants much better than Copeland, to *Dryopteris* subg. *Goniopteris* on habital grounds lack stellate hairs altogether so far as can be ascertained, and in two other species (*D. glochidiata* and *D. ancyriothrix*) the branching is reduced to a mere forking at the apex. More importantly, branched hairs *do* occur in other groups, e.g. in *Thelypteris thomsonii* (Jenm.) Proctor, *T. canadasii* (Sodiro) Alston, *T. macradenia* (Sodiro) Morton, *T. andina* (Morton) Morton, and *T. boliviensis* (Morton) Morton, which according to their venation and obvious relationships belong with *Thelypteris decussata* (Swartz) Proctor in *Thelypteris* subg. *Lastrea* sect. *Glaphyropteris*, rather than in *Goniopteris*. On the other hand, *Goniopteris* has an equally obvious relationship to *Meniscium*, which has unlobed pinnae and consequently completely anastomosing (meniscioid) venation, and admittedly (by both Christensen and Copeland) *Goniopteris* differs only in having "stellate" hairs.

The obvious inadequacy of recognizing *Goniopteris* as a genus distinct from *Cyclosorus* and *Meniscium* mentioned above is paralleled, even more strongly, in considering the generic distinctness of, in Copeland's sense, *Cyclosorus* and *Lastrea*. The entire "generic" description given by Copeland for *Cyclosorus* is "Like *Lastrea* in every respect except that at least the lowest veins of the adjacent segments meet and unite

at or below the sinus." If genera can be distinguished like this on a single artificial character the whole system of fern classification would have to be radically altered. For this *is* an artificial character which separates closely allied species like *D. dentata* and *D. normalis* into different genera, even when one has difficulty sometimes in even placing specimens into a species because free and united veins can be found on the same frond. In spite of its free veins, *D. normalis* (and of course its allies *D. patens*, *D. augescens*, *D. serra*, and others) is a *Cyclosorus*, as recognized without question by Christensen, who described it, Maxon, Weatherby, and others. *Cyclosorus* can be distinguished from subg. *Lastrea* by the character pointed out by Christensen: Veins reaching the margin above the sinus in *Lastrea* and veins convenient to the sinus or uniting within the leaf tissue in *Cyclosorus*, characters that really do seem to group the species according to relationships. The complete artificiality and inconsistency of Copeland's treatment is most clearly shown here: That species with the veins merely connivent to the sinus and not united are excluded from *Cyclosorus* and that in the exactly similar case species with free connivent veins and with united veins are admitted without question to *Goniopteris*. Although intentionally evolutionary, Copeland's work here, as elsewhere, is a fine example of the kind of taxonomy called "apriorism" by Simpson (1961), a classification by a priori assumptions as to the importance of certain characters, and if the plants (or animals) don't agree, so much the worse for them.

As to the generic name *Thelypteris*, enough has been written. A proposal to conserve the name *Lastrea* in the sense of Copeland and to reject *Thelypteris* was rejected by the International Committee on Nomenclature (Pteridophyta), and *Thelypteris* has now come into general use by the various members of the nomenclature committee who ought to know best—Alston, Holttum, and Madame Tardieu-Blot, and it has even given its name now to the family Thelypteridaceae. Of course, the fact that *Thelypteris* appears in the list of Nomina Conservanda as a rejected name in favor of *Dryopteris* only means that *Thelyp-*

teris is rejected when it is combined with *Dryopteris* and not that it may not be used when segregated as a different genus, for the types of the two names are not the same.

Although these various groups of species are not sharply delimited by the characters that have thus far been employed, as exemplified above in the comparisons between *Cyclosorus*, *Goniopteris*, and *Meniscium*, it is perhaps still desirable to have some grouping of the species, however arbitrary. Christensen is still the most reliable authority on these plants, and so the species may, for the present at least, continue to be divided into the groups that he recognized in his "A Monograph of the Genus Dryopteris" (1913, 1920). But in adopting the name *Thelypteris*, several new combinations are needed, for purely nomenclatural purposes:

THELYPTERIS Schmidel, Icon. Pl., ed. Keller, 45. *t. 11, 13.* 1762.

Subg. THELYPTERIS. Lectotype: *T. palustris* Salisb.

Subg. LASTREA (Bory) Alston, Jour. Wash. Acad. Sci. **48:** 232. 1958.

Lastrea Bory, Diet. Class. Hist. Nat. **6:** 588. 1824.

Dryopteris subg. *Lastrea* C. Chr., in Rosenv., Biol. Arb. Warming 79. 1911.

Sect. LASTREA. Type: *Polypodium oreopteris* Ehrh.

Sect. GLAPHYROPTERIS (Presl) Morton, Amer. Fern Jour. **51:** 31. 1961.

Glaphyropteris Presl, Abh. Boehm. Ges. Wiss. V, **5:** 34. 1848. Type: *Polypodium decussatum* L.

Dryopteris subg. *Glaphyropteris* C. Chr., in Rosev., Biol. Arb. Warming 80. 1911.

Thelypteris subg. *Glaphyropteris* Alston, Jour. Wash. Acad. Sci. **48:** 234. 1958.

Subg. **Cyclosorus** (Link) Morton, *comb. nov.*

Cyclosorus Link, Hort. Reg. Bot. Berol. **2:** 128. 1833.

Dryopteris subg. *Cyclosorus* C. Chr., Ind. Fil. XXI. 1905.

Sect. CYCLOSORUS. Type: *Aspidium gongylodes* Schkuhr.

Sect. **Steiropteris** (C. Chr.) Morton, *comb. nov.*

Dryopteris subg. *Steiropteris* C. Chr., Biol. Arb. Warming 81. 1911. Lectotype [C. Chr., Ind. Fil. Suppl. **3:** 6. 1934]: *Polypodium deltoideum* Swartz.

Sect. **Leptogramma** (J. Smith) Morton, *comb. nov.*

Leptogramma J. Smith, Jour. Bot. **4:** 51. 1841. Lectotype [C. Chr., Ind. Fil. XXI. 1905]: *Leptogramma totta* J. Smith [=*Thelypteris pozoi* (Lagasca) Morton].

Dryopteris subg. *Leptogramma* C. Chr., Ind. Fil. XXI. 1905.

Sect. **Goniopteris** (Presl) Morton, *comb. nov.*

Goniopteris Presl, Tent. Pterid. 181. 1836. Lectotype [J. Smith, Hist. Fil. 190. 1875]: *Polypodium crenatum* Swartz. The lectotype indicated by Copeland [Gen. Fil. 145. 1947], namely *Polypodium viriparum* Raddi, is inadmissible, since it was not one of the original species mentioned by Presl, and furthermore the prior choice of *Polypodium crenatum* as lectotype by Smith can not be displaced, since *P. crenatum* was one of the original species and since it does agree with Presl's generic characterization. Incidentally, it is a fine choice in other respects too, since it is well known, widespread, and generally "typical" of *Goniopteris*. Unfortunately, Swartz's name was a later homonym when published and the species must therefore be known today as *Thelypteris poiteana* (Bory) Proctor.

Nephrodium sect. *Goniopteris* Diels, in Engl. & Prantl, Nat. Pflanzenfam **1**[4]: 177. 1894.

Dryopteris subg. *Goniopteris* C. Chr., Ind. Fil. XXII. 1905.

Sect. **Meniscium** (Schreber) Morton, *comb. nov.*

Meniscium Schreber, in Linn. Gen. Plant., ed. 8, **2**: 757. 1791.

Type: *Polypodium reticulatum* L.

Phegopteris subg. *Meniscium* Christ, Farnkr. Erde 269. 1897.

Dryopteris subg. *Meniscium* C. Chr., Ind. Fil. XXII. 1905.

LITERATURE CITED

CHRISTENSEN, C. 1913. A Monograph of the Genus Dryopteris. Part I. The Tropical American Pinnatifid-bipinnatifid Species. Kgl. Danske Vid. Selsk. Skr. VII, **10**: 55-282. fig. 1-46.

———. 1920. A Monograph of the Genus Dryopteris. Part II. The Tropical American Bipinnate-decompound Species. *ibid.* VIII, **6**: 1-123, fig. 1-29.

MORTON, C. V. 1950. Notes on the Ferns of the Eastern United States. Amer. Fern Jour. **40**: 213-225; 241-252.

SIMPSON, G. G. 1961. Principles of Animal Taxonomy. Columbia University Press.

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Remarks on the Care of Ferns in Cultivation

Fay MacFadden

In the Los Angeles area many kinds of ferns grow well, but they require care and some knowledge about gardening. I have had practical experience with them for many years—and some success. Everyone must learn things for himself, but there are a few hints that may be helpful. Your garden is better without unhealthy ferns. If you can't keep them healthy, they will probably die.

Location

Ferns will stand some sun, but most of them appreciate shade. The light shade of a lath house is most appropriate. Some ferns are hardy enough to stand wind, but when so exposed have ragged fronds and seldom look well, so it is essential to have your growing area protected from wind, whether the shade is provided by lath or trees. The sides of a fern plot should be protected by windbreaks of shrubs or a fence, especially along the west side, in the Los Angeles area. When we get the hot dry winds from the desert, which usually occur in the fall but may come at any time, humidity is very low. The ferns stand this dry atmosphere best in the fall, when the growing season is over and the next year's fronds still are snugly rolled up. In the spring, winds cause more damage. Spraying ferns daily, as well as the laths, walks and walls nearby, will help to increase humidity during the dry spells. Unfortunately, our Los Angeles water leaves deposits in the soil that are not desirable, but they do less damage than searing, dry winds! Baskets especially should be watched for dryness, but one should be careful not to water them too much. Water frequently rather than copiously.

Naturally, the proper situation requires careful preparation of beds, with good, loose, well-drained soil. Many ferns should be planted beside rocks, as their roots get under the rocks and keep cool and moist. Also, such rocks help provide good drainage.

Fertilizing

When I first started to grow ferns, I fertilized with a little

blood meal or manure water, but I soon found that ferns not fertilized grew just as large and that I was using a lot of energy unnecessarily. For the past 20 years I have not fertilized my ferns. Contrary to popular belief, ferns do not require a lot of nitrogen. Actually, with unhappy ferns, fertilizer may hasten their demise.

However, if a gardener understands the principles of fertilizing he can use it on ferns with no bad results. If I were going to fertilize ferns I would do so very often but with a very weak solution. I would use manure water in the hanging baskets and perhaps small amounts of blood meal on the ground. Some of the coarser ferns stand considerable fertilizer.

In getting plants ready for shows, fertilizer probably has to be used. Nurserymen also find it necessary to use fertilizer to bring their plants along quickly. Ferns grown in pots may require frequent use of a weak solution of fertilizer.

Although I do not fertilize, I mulch my ferns at least twice a year. Peat, leaf mold, or forest humus may be used. The "forest humus" that comes sacked from the high Sierra Nevada is ground up fir bark and humus, is a real soil conditioner, and will last some time after peat will be gone. A mixture of forest humus and American peat makes a good mulch too; this American peat also comes from the Sierra Nevada.

PRUNING

Good grooming in the fern garden is a necessity if your ferns are to look their best; therefore pruning is an important part of gardening. Most of the winter you can forget your ferns, but during the growing season a little pruning here and there makes everything look better. I cut out the old fronds in the spring, and all summer long I remove fronds that have lost their beauty. Some lazy gardeners have made themselves believe that it is bad for the ferns to cut old fronds, and so their ferns never look well. In nature, this may be true, as the old fronds lie over on the ground and protect the soil from drying winds and keep the roots cool and eventually help to form humus. However, a good

gardener lays down a mulch to take the place of nature's way, and he is rewarded with beautiful plants with no dead or dying fronds. Every fern grower should prune his own ferns, because a hired gardener may unintentionally injure or destroy the plants.

Near the coast, many ferns, such as most of the species of *Pteris*, may be cut clear back in the fall. However, inland it is better to leave all but the worst fronds on through the winter until the danger of frost is past, then all the old fronds should be cut off just above the new fronds starting to grow. In this way one does not injure the new fronds while trying to get at the old ones.

After the ferns are pruned in the spring, clean up around them, but never cultivate around the roots of a fern, for their roots are very close to the surface and are damaged easily. Still, it is important to remove debris, both for the sake of looks and to destroy insects that may be lingering there.

PROPAGATION

Many ferns should be divided every two or three years. This should be done in the spring just as the new roots are beginning to grow. Many, if not most, ferns transplanted in the fall die unless enough soil has been moved with the plant to avoid disturbing the root system. Incidentally, when you divide ferns never throw away divisions if you can give them away. Your fern collection may be built up by trading ferns, but if that is not practical, give away your extra plants anyway. You may make a fern convert when you least expect it. As fern growers, it is essential that we interest as many people as possible in the cultivation of these plants. If you give a rare fern to a friend, be sure you keep a growing tip, you may not kill the part you need. When you divide ferns and give away some of the divisions be sure you keep the growing tip, the "toe," as some gardeners call it. If you do remove this tip, you may not kill the part you keep, but it may be a year or more before a vigorous new growing tip forms. The epiphytes, such as the Davallias, Humatas, Pyrrosias and Polypodiums, may be divided and given

away freely. They have long-creeping rhizomes, and one can always find a rhizome section with healthy roots.

TREATMENT FOR PESTS

I have never sprayed for insects. Good soil, mulching, and removal of debris and old fronds has taken care of the pests for me. A few species of ferns, such as *Onychium japonicum*, *Cyrtomium falcatum* cv. 'Rochfordianum,' and some *Nephrolepis* species, become infested with scale insects, but removal of infested fronds is the end of the matter. When spray must be used, malathion in a weak solution seems best.

There is an insect that lays eggs on the stipe of *Asplenium bulbiferum* before the fronds unroll, usually in winter or early spring. The larvae eat a hole in the large and succulent stipe, and when the frond is only a few inches high it topples over and dies. I found a group of tick-like mites on one of these stipes, which were identified as mites that live on insect larvae. This year I put moth balls around the rolled up fronds and have had no further trouble with them. Nothing else I tried did any good. I have also found the rhizomes of *Polypodium diversifolium* with similar tick-like mites.

Under glass, there are other pests—mealy bugs, brown-scale, and black aphids. My usual method of getting rid of such things is to cut off infected fronds. The black aphids occur on new, rolled up fronds and are troublesome. I usually wash them away with a soap or detergent solution.

In Los Angeles, snails and slugs are sometimes a problem. Snail bait should be put out once or twice in the spring, and perhaps in the fall. Afterward the snails should be picked up and destroyed, for some snails do not eat enough poison to kill them and are merely knocked out temporarily. I never use anything containing arsenic, because this is dangerous to other animals, such as toads and frogs. I keep some pet frogs and toads in the lath house, as they eat many insects and are interesting to watch and hear.

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A Fern Garden at the Fresno Museum

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Previous articles in the American Fern Journal have reported the establishment of major fern gardens in a few of the larger cities. These were projects of large scope, connected with great institutions and undertaken by rather large groups of people, including well known botanists. They have provided outstanding contributions to those communities

I will describe a less pretentious project of this nature, a one-man endeavor in the smaller city of Fresno, California. The methods employed will be outlined and some of the problems encountered by an amateur attempting such a project recounted. Most of the difficulties have now been solved, a fair degree of success has been attained, and the fern display is beginning to shape up nicely.

The Fresno Museum is a fairly new and still small institution. It depends heavily on donations of materials and exhibits but, under the able supervision of Edward Gomes, Director, it is expanding steadily. One of its prime functions is to serve the local school system. The fern collection was planned for use by science classes and for general exhibition purposes.

TERRAIN AND CLIMATE

Fresno, population 147,000, is situated in the San Joaquin Valley midway between San Francisco and Los Angeles. This area, in the lower Sonoran life zone, approaches desert conditions and has achieved its agricultural position only by extensive irrigation. The average annual rainfall of 9 inches occurs mainly between November and April, with none during summer months.

Summers are hot! The normal daily maximum temperature for nearly three months is about 100°F. with frequent hot spells to 106°F. and occasionally to 110°F. Midsummer minimum humidity is often under 15% and sometime under 10%. Winters are cool with frequent frosts and occasional cold spells to 20°F.

These are not ideal conditions for outdoor fern culture, yet, by reasonable attention to water, soil, and shade requirements, I

have had fairly good success in raising a rather wide assortment of ferns in my home garden.

As the floor of the valley is level, the 10-acre museum site contains no ravines, hillsides or other natural settings for a fern display. The trees are still too small to provide adequate shade. The only suitable place is the north side of the main building.

There a small strip, 20 feet long and 5 feet wide, was developed as a raised bed surrounded by a low wall of native granite. The sandy-loam soil was improved with peat moss and leaf mold. Planting commenced in the early spring of 1961.

The original concept was that only native ferns would be appropriate as the original scope of the "Museum of Natural History" was restricted to the fauna and flora of California. By late summer, when a native fern collection of about 25 species had been planted, the institution's name was shortened and its activities expanded. This permitted inclusion of exotic ferns and some were added during the fall, after extending the raised bed to the full 65 foot length of the building.

COLLECTING AND PLANTING

Planting continued through the spring, summer, and fall of 1962 as additional plants became available. The source of native plants was largely from collections made during field trips to various parts of the state. Some were secured by trade with other fern hobbyists and with the Santa Barbara Botanic Garden; and a few were purchased from a nursery specializing in native plants. The Museum already had a collecting permit from the U. S. Forest Service, and I obtained personal permits from Yosemite, Kings Canyon and Sequoia National Parks to do limited collecting in unfrequented places away from roads, trails and campgrounds. Exotic ferns were largely dupliecate plants from my personal garden.

As I am not a botanist, but only an amateur gardener with a love of ferns and a reasonably green thumb, I was unable to make a very scientific approach to this project, and had to rely heavily on trial and error. An expert would have known that some

plantings were doomed to failure, but all I could do was try once or twice with each species I acquired to see what would happen.

A special problem was the impossibility, in a small area, of varying the situation to meet the ideal growing conditions for each species. Nothing within reason can be done about the high summer temperature and low humidity and the museum cannot be expected soon to provide protection against winter freezes. The less hardy evergreen ferns were planted against the building under the wide eaves.

Very little variation in shade is possible. In winter, sunlight never reaches this north exposure. During summer, too much sun for most varieties strikes it, particularly the west end in the hot late afternoon. A lath trellis was built at that end and a lath cover placed over the original section. In a couple of years nearby trees will cover the bed. Thus, the degree of shade is now and always will be almost uniform throughout the area; it will be too much for some species and not enough for others.

When problems with the irrigation system are solved, some variation in moisture to fit individual needs will be possible. Plants of similar needs have been grouped together; low dikes can be graded to separate such groups and the bubbler heads adjusted to deliver more water in some sections than in others.

In this overly uniform situation it was expected, and experience so far confirms, that some species would find near-perfect growing conditions and would thrive, others could tolerate the situation and become fairly satisfactory specimens, some would do poorly, and some would die. Species that died will be replanted once or twice before abandoning the attempt to grow them.

While the basic soil mixture was believed suitable for many types, pockets of special mixtures were provided for some. These were either soils unusually rich in humus or the actual soil in which the plants were found growing, many in nearly pure decomposed granite. Rock-loving natives were planted between or against head-size rocks of the kind with which they were associated in nature.

PROBLEMS AND DISAPPOINTMENTS

During the early part of the first summer the first problem to show up was that of proper irrigation. A hose laid down and allowed to run only in one spot gave too much water nearby and none in the far corners. Once a watering period was missed entirely and the bed became too dry. Several plants wilted to the ground; the Deer Fern and Sword Fern died.

An irrigation system was then installed, consisting of underground pipes with bubbler heads on risers. This was expected to solve the watering problem but last summer another difficulty arose. The drilling of a city water well nearby stirred up sand in the water-bearing strata which caused continual clogging of the museum's lines and bubbler heads fed from its private well, which again caused erratic watering of the ferns.

Some difficulities developed from the type of labor used. The museum's limited budget permits hiring only a few supervisory personnel and for common labor it depends on inmates from the county prison farm. Such men have little knowledge of, and less interest in, gardening. For example, when the bubbler system was finished, one of the laborers was instructed in its use. Upon returning later, the supervisor found him watering with a hose, aiming a powerful stream directly at tender plants and knocking most of the fronds onto the ground. It was several weeks before the Lady Ferns, the Five-fingers, and others recovered from that beating.

Later, the museum was given a load of wood chips for a mulch but the mixture contained some chunks entirely too large for this purpose. The laborer spreading the material threw it indiscriminately in shovelsful, breaking many fronds and burying many small plants. Again it was a sad looking bed for some time.

There were other troubles, including too-late erection of the lath cover and trellis, causing rather bad sun-burning of some plants. However, it is believed most of our troubles are behind us and the display is beginning to look more as it should. It will be at least another year before I will be satisfied with it. Young

plants then will be approaching maturity and clumps will be larger. I will be able to increase the number of plants of some species, most of the ones that have died will be replaced, and perhaps several more species can be added.

TYPES PLANTED

The theme of this project is variety, rather than quantity. Large beds of a single species are impressive but space limitations preclude such treatment here. For the educational purpose intended, as large a number of species as possible is preferable. Even so, there are fair-sized groups of Southern Maidenhair, Lady Fern, Brittle Fern, and a couple of Polypodies, but most of the species are represented by only one to three plants. Some of the single plants are quite large and showy, such as two species of *Woodwardia*, one of *Microlepia*, and an unknown bracken.

My ultimate objective is to include in the collection nearly all of the 60-odd species and varieties indigenous to California that can grow in this environment, plus a reasonable assortment of exotic species.

The following ferns have been planted, classified to the best of my ability. The nomenclature in Wherry's *The Fern Guide* is followed for the eastern ferns and for wesern natives I use that in Munz and Keck's *A California Flora*, except for names that Tryon suggested be changed.

LIST OF FERNS PLANTED AT THE FRESNO MUSEUM

Adiantum bellum
A. capillus-veneris
A. hispidulum
A. jordanii
A. pedatum
A. pedatum var. aleuticum
Aglaomorpha coronans
Asplenium bulbiferum
Athyrium angustum var. rubellum
A. alpestre var. americanum
A. filix-femina var. californicum
A. filix-femina var. sitchense
Blechnum spicant
Cheilanthes californica
C. cooperae
Onychium japonicum
Pellaea adiantoides
P. andromedifolia
P. breweri
P. bridgesii
P. falcata
P. mucronata
Pityrogramma triangularis
P. triangularis var. pallida
Platycerium alcicorne
Polypodium aureum
P. californicum
P. californicum var. kaulfussii
P. glauco-pruinatum
P. glycyrrhiza

Cheilanthes gracillima
C. intertexta
C. siliquosa
Cystopteris fragilis
Cyrtomium falcatum
Cryptogramma acrostichoides
Davallia mariesii
Dryopteris arguta
D. dilatata
D. erythrosora
D. filix-mas
D. filix-mas var. cristata
D. goldiana
D. parallelogramma
Gymnocarpium dryopteris
Lygodium japonicum
Microlepia strigosa
Nephrolepis philippinensis
N. exaltata cv. 'Bostoniensis'
N. exaltata cv. 'Rooseveltii'
N. exaltata cv. 'Whitmanii'
Notholaena jonesii
N. parryi
Onoclea sensibilis
Polypodium scouleri
P. subauriculatum cv. 'Knightii'
Polystichum acrostichoides
P. angulare
P. dudleyi
P. lonchitis
P. munitum
P. munitum var. curtum
P. munitum var. imbricans
P. setosum
P. tsus-tsimense
Pteridium aquilinum var. pubescens
Pteridium sp.
Pteris tremula
P. vittata
Pteris cretica cv. 'Wilsonii'
Rumohra adiantiformis
Tectaria cicutaria
Thelypteris nevadensis
T. puberula
Woodsia oregana
W. scopulina
Woodwardia fimbriata
W. radicans

Plant labels have been made giving the common and botanical names. The label posts are of ½" aluminum channel, the top part bent back at an angle of about 30° to facilitate reading from a standing position. On the bent top is fastened a piece of sheet aluminum about 1" x 4." The names are embossed by a "Dymo Tapeprinter" in white raised letters on a dark green plastic tape. The adhesive back of this material holds it firmly on the aluminum plates.

SUCCESSES AND SATISFACTIONS

By reciting the problems encountered, I hope I have not given the impression that everything went wrong and that the project is a failure. That is far from the case. I mentioned those difficulties to alert any other amateur who may be considering such an attempt to some of the things he may encounter. And I do commend this type of activity to other Fern Society members. I believe a rather large field of public service is open to us. All it takes a little interest, a little spare time, and a reasonable amount of effort.

At the end of the second growing season, the Fresno Museum's fern bed presented a fairly good but not completely satisfactory appearance. A few of the earlier plantings succumbed from freezing or insufficient water during hot spells.

Of the 82 species planted, 66 are still alive and thriving to various degrees. While some are still very small plants and others are not very healthy looking, a few have made a lush growth and are representative of their species. It is too soon to forecast the fate of the most recent plantings.

In spite of the many set-backs and disappointments in the early stages of this project, the more recent successes and the present condition of the plants leads me to the optimistic belief that, when the watering and shade problems are completely solved, a presentable fern display will exist with a significant number of species. It is already attracting many visitors.

It has been an engrossing and satisfying experience. It has provided an opportunity to make a small contribution to my community. Further, it has stimulated me to increase my knowledge of ferns, particularly in the field of taxonomy.

If I were starting such an endeavor again, I would proceed more slowly in at least the following respects, and these would be my suggestions to any other amateur considering such a project:

1. Refrain from starting planting until adequate provisions for watering and shade are installed.

2. Keep small plants in the home garden where they can be "babied" until they attain enough maturity to withstand some degree of neglect.

3. Newly acquired types from radically different environments should be grown in the home garden, preferably for a full cycle of seasons, to determine their adaptability to the locality and their need for moisture and shade, before planting in the public garden.

1904 FARRIS AVENUE, FRESNO, CALIFORNIA.

(Mr. Taylor has written recently that an administrative change has resulted in neglect and loss of many of his beloved ferns during the third season.—I.L.W.)

Shorter Notes

STORMESIA KICKX F., AN OVERLOOKED FERN GENERIC NAME.—Neither Christensen in his Index Filicum (including the supplements) nor Copeland in his Genera Filicum cite the genus *Stormesia*, created by Jean Kickx fil.[1] for *Asplenium septentrionale* (L.) Hoffm. I think it is well to give here the two passages by Kickx relative to the name *Stormesia*, because the book in which it appeared[2] is rare.

p. 8: "Ordre III. FOUGÈRES *Rich.*

†Un tégument s'ouvrant du côté interne.

4. ASPLENIUM *Willd.* Sores linéaires, obliques à l'axe longitudinal de la feuille ou de la foliole, confluents à mesure qu'ils se développent. Tégument membraneux.

5. STORMESIA *Nob.* Sore linéaire, longitudinal, recouvrant tout le disque du sommet de la feuille. Tégument scarieux.". . .

p. 10-11: "Genre 5. STORMESIA *Nob.*

Acrostichi sp. *L.* Asplenii sp. *Sw.* Pteris sp. *Sm.* Blechni sp. *W.*

13 .S. . . BIFURCA *Nob.* Acrostichum septentrionale *Linn.* Asplenium bifurcum *Op.* DESMAZ. Crypt. fasc. IV. no. 199.

Racine fibreuse. Pétiole pourpré à sa base, mince, très long, se bifurquant aux ¾ de sa hauteur en feuilles linéaires aigues bi ou tri-dentées, dont les unes, étroites, sont capsulifères; les autres, plus larges, stériles.

Ce genre diffère de l'Acrostichum par la présence du tégument: de l'Asplenium par la disposition des sores. Nous le dédions à la mémoire de Jean Storms de Malines, docteur en médecine et maître es-arts, professeur primaire de philosophie à l'université de Louvain, auteur d'une des plus anciennes monographies d'espèce que l'on connaisse, publiée en 1607 et intitulée "De rosâ hierochuntinâ liber unus in quo de ejus naturâ, proprietatibus, motibus et causis pulchre disseritur."

Sur les roches schisteuses entre *S.Remy* et *Jodoigne*. Feu M. Deronnay l'avait observé aux environs de *Quenast*. Rare."

If *Acrostichum septentrionale* L. is segregated from *Asplenium* L. as another genus, this other genus should be named *Acropteris* Link (1833), which has priority. *Stormesia* is thus a synonym either under *Asplenium* or *Acropteris*.—ANDRE LAWALRÉE, *3 Av. Van Elderen, Bruxelles 16.*

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[1] Jean Kickx, filius, was born in Brussels on January 17, 1803, died September 1, 1864.

[2] Kickx, J. Flore cryptogamique des environs de Louvain, ou description des plantes cryptogames et agames qui croissent dans le Brabant et dans une partie de la province d'Anvers. XV-263-(24) pp. Bruxelles, Vandooren. 1835.

Recent Fern Literature

"A FLORA OF THE ALASKAN ARCTIC SLOPE,"[1] is a recent publication of our editors, Ira L. Wiggins and John H. Thomas. It represents the result of several years of field-work in northern Alaska (in the Brooks Range and on the tundra extending northward to the Arctic Ocean), and of years of herbarium study of the plants collected. The book is largely devoted to the phanerogamic flora, which totals 419 species. In this cold region ferns and fern-allies are naturally few, numbering only 16 species, namely *Lycopodium selago, L. annotinum, Selaginella sibirica, Equisetum arvense, E. pratense, E. limosum, E. palustre, E. variegatum, E. scirpoides, Botrychium lunaria, Woodsia glabella, W. alpina, W. ilvensis, Cystopteris dickieana, C. fragilis,* and *Dryopteris fragrans*, all of which occur farther south in Canada and the United States (except *Selaginella sibirica*).

The treatment is excellent, with fine original descriptions and maps showing the geographic distribution. The only point deserving criticism is the adoption of the name *Equisetum limosum* L., instead of the usual *E. fluviatile* L., in which the authors are following Hultén's "Flora of Alaska and Yukon," but in this instance I think that Hultén is wrong; at least he has not justified his usage. These two names being of the same date (1753), the choice between them must be governed by Article 57 of the International Code of Nomenclature: "The author who first unites taxa bearing names or epithets of the same date has the right to choose one of them, and his choice must be followed." In this case, John H. Schaffner, the specialist on *Equisetum* and its literature, showed in an article "The Proper Name of the Water Horsetail"[2] that Ehrhart had pointed out that the branched form (*E. fluviatile*) and the unbranched (*E. limosum*) were not specifically different and that he consequently proposed a new name, *E. helcocharis* Ehrh. for the combined species, a procedure not allowable under the Code. Later Ehrhart wrote (in

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[1]By Ira L. Wiggins and John Hunter Thomas. Arctic Institute of North America Spec. Publ. 4, pp. 1–425. University of Toronto Press, 1962.

[2]THIS JOURNAL **26:** 91–94. 1936.

1787): "*Equisetum limosum* L. ist eine Abart von dessen [i.e. Linnaeus'] *E. fluviatile*," thus effectively indicating that *limosum* is a subspecies of *fluviatile*, and establishing *fluviatile* as the accepted name. In 1792 Ehrhart followed the treatment, using the name *E. fluviatile*, and discarding *limosum* and his own *heleocharis* entirely. The opposite treatment, in which *limosum* is adopted and *fluviatile* placed as a synonym, is of later date (Roth, 1800). No one has disputed Schaffner's evidence, and the name *E. fluviatile* has been generally adopted since, as in Braun's Index to North American Ferns, Fernald in Gray's Manual, eighth edition, and Morton in Gleason's New Illustrated Flora. Authors wishing to use the name *E. limosum* L. will have to justify it by showing that someone prior to Ehrhart (1787) had adopted this name and reduced *E. fluviatile* to synonymy or to some subspecific category.—C. V. M.

AN APPRAISAL OF THE GENUS CYSTOPTERIS.—A recently published study[1] of the small but world-wide genus *Cystopteris* is so well worked out that it is to be recommended to every fern student as a guide for treating any group of comparable scope. After a résumé of past views as to the relationships of the genus, the morphology and anatomy, with procedures for their investigation, are discussed. The spores are all bilateral monolete, and mostly echinate, rarely grading into rugose in the so-called *C. dickieana*, which is considered unworthy of taxonomic recognition. The gametophyte shows some variation, especially as to prothallial hairs.

On the young sporophyte the vein-position characterizing individual taxa appears on the very first frond; the stipe of up to the third or fourth fronds, bears hairs, scales appearing only on later ones. The root, rhizome, and scales of the mature sporophyte are described briefly, and the leaf in more detail. The pigmentation and relative length of the stipe prove to be of some significance, but the position of bundles as seen in cross-section does not. Certain taxa are characterized by various

[1] Blasdell, Robert F. 1963. A monographic study of the fern genus Cystopteris. Mem. Torrey Club **21** (No. 4): 1–102, *23 pls.*

sorts of hairs and bulblets. Especially important is the position of vein-endings: In the majority of species these run to the bases of notches, but in two species they run to the tips of the teeth. Cases where both positions appear on the same plant are interpreted as the result of "introgression." The epidermal and indusial cells, which are fully figured, are also of taxonomic significance.

Since the publication of Manton's treatise on fern cytology in 1950, ferns have been much studied from this viewpoint, and in the present genus the results have proved highly interesting. The basic chromosome number, $n = 42$, is shown by only two wide-spread North American species, *C. bulbifera* and *C. protrusa*. In contrast, *C. fragilis* has been found with three levels of polyploidy: tetraploid, hexaploid, and octoploid. The average spore size is sufficiently correlated with degree of ploidy to be used for ascertaining this situation in specimens available only in the herbarium. Noteworthy too is the finding that the higher ploidy levels occur toward the north.

Seven pages are devoted to various aspects of hybridization. The intricacies of the *C. fragilis* complex, which have confounded taxonomists in the past, are held to be the result of introgression between *C. fragilis sensu stricto*, in which the veins end in the teeth, and a hitherto poorly known pan-tropical species, *C. diaphana* (Bory) Blasdell, in which the veins end in the sinuses. Plants varying in vein-tip position, as shown on the distribution map on the final page, occur outside the tropics far north into Alaska, Greenland, and northern Scandinavia. Accordingly, it is postulated that spores from hybrids produced in the tropical uplands where the ranges of the two species overlap, have been blown far and wide. Such spores have produced the widespread, uniform population in eastern North America known as *C. fragilis* var. *mackayi*. An alternative view, noted on page 55 as suggested by Wagner, seems more reasonable: In a past warmer geological period, when the ranges of the diploids *C. diaphana* and *C. protrusa* overlapped farther north, a hybrid between them be-

came tetraploid and fertile, and spread widely where it became established and is now known as *C. fragilis* var. *mackayi.*

Blasdell's studies lead to a taxonomic revision of the genus, outlined in a key on page 37, ten species being recognized. Synonymy is cited, a diagnosis given, and comments made about significant relationships. Following the taxonomic treatment is one dealing with the inferred hybrids.

The paper concludes with a long list of cited specimens, selected from among about 5,000 sheets examined; a list of literature consulted; and a series of illustrations, including instructive drawings of parts of individual taxa. There remain to be carried out, experimental studies of the postulated infra- and inter-specific hybrids to ascertain whether or not they can be confirmed.—EDGAR T. WHERR, *University of Pennsylvania.*

American Fern Society

TRAVEL TO THE 10TH INTERNATIONAL BOTANICAL CONGRESS, EDINBURGH, AUGUST 3-12, 1964. The Botanical Society of America has appointed a committee to receive applications and recommend grants toward the cost of travel to the forthcoming congress. Professional botanists who are citizens of the United States are eligible to apply. They need not be members of the Botanical Society. The deadline for receipt of applications is February 15, 1964 and awards will be announced on or about April 1. Application forms may be obtained from Ralph E. Cleland, Chairman of Travel Grant Committee, Department of Botany, Indiana University, Bloomington, Indiana.

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ERRATA

Page 7, line 13: Add second quotation mark after "*D. campyloptera.*"
Page 33, line 24: For "*Pellea*" read "*Pellaea.*"
Page 64, line 4 from bottom: For "Kuhn" read "C. Chr."
Page 64, bottom line: Add after "1897" "*nom. nud.*"
Page 64. Add line at bottom "*Dryopteris sancta* var. *portoricensis* C. Chr. Smiths. Misc. Coll. 52, no. **1867**: 380. 1909.
Page 68, line 21: For "(US))" read "(US)."
Page 77, line 3 from bottom: For **"glandulosa"** read **"glandulosum."**
Page 101, line 27: For "*scolopendrium*" read "*scolopendria.*"

Suggestions to Contributors to the American Fern Journal

1. Authors of papers submitted to the *American Fern Journal* should consult the *Style Manual for Biological Journals* (1960) and be guided by its examples.

2. The "name-and-year" system for bibliographic references will, except in exceptional cases, be used. (See Literature Cited below for an example).

3. Authors are encouraged to use the journal abbreviations set forth by Schwarten and Rickett (1958, 1961).

4. Abbreviations of names of herbaria will be those listed by Lanjouw and Stafleu (1959).

5. Reports of chromosome numbers will not be accepted unless documented.

6. The use of footnotes and tabular matter should be kept to a minimum.

7. All manuscripts submitted for publication should be typed, double-spaced, and have ample margins.

8. Reprints should be ordered when galley proof is returned to the Editor. An order blank will be included with the galley proof.

Literature Cited

American Institute of Biological Sciences, Committee on Form and Style of the Conference of Biological Editors. 1960. Style Manual for Biological Journals. American Institute of Biological Sciences. Washington, D. C. 100 p.

Lanjouw, J., and F. A. Stafleu. 1959. The Herbaria of the World. Index Herbariorum, Regnum Veg. **15**: 1-249.

Schwarten, L., and H. W. Ricket. 1958. Abbreviations of Titles of Serials Cited by Botanists. Bull. Torrey Club **85**: 277-300; 1961. Supplement I. Ibid. **88**: 1-10.